connection I invite your attention to Dr. A. E. Barclay's Silvanus Thompson Lecture on "The Danger of Specialisation" delivered before the British Institute of Radiology on December 5th, 1930 (*Lancet*, December 13th, 1930), in which he makes some significant remarks on the modern tendency to specialise in the medical profession and its attendant dangers. Still more significant are his references to certain defects in the medical curriculum. The specialist is defined as a man who knows more and more about less and less, while the practitioner is one who knows less and less about more and more. And it is in this, according to Dr. Barclay, that the danger lies. Opinions may differ about the value of specialisation, but there is a good deal of truth in what he says about medical education.

He states, in effect:—

(*a*) That the existing medical curriculum is much too long. It is nearer eight than seven years before a student can qualify.

(*b*) That it is not till a student has qualified that he is able to take responsibility and see his life-work from an angle that is far different from that of examinations.

(*c*) That there is not enough opportunity for the student to get the general education on which to base his long years of purely specialist study.

(*d*) That the medical curriculum has become unwieldy owing to the large and ever-increasing number of subjects that are thrown into it.

(*e*) That it is sometimes forgotten that to the medical student the most essential of all studies is the study of man. This he has to learn for himself. No teaching except

that of mother wit can give him the wisdom, that leads to an understanding of human nature. The student has little chance of developing this essential part of his training.

(f) That there is a wide gap between the subjects of anatomy and physiology and the subjects of the final years.

There is nothing new in these observations. Many of us who have to do with the medical education have felt the same. The length and unwieldiness of the medical curriculum is a problem that needs to be investigated. The medical curriculum in the Indian universities is much the same as in British universities. In Bombay, for instance, after matriculation the student spends two years in an Arts College where he studies English, a second language, mathematics, physics, chemistry and biology. After the Intermediate Science Examination he joins the medical college, where during the first five terms (one academic year is composed of three terms of 12 weeks each), he studies human anatomy and embryology, physiology, organic chemistry and biophysics. The next three years (nine terms) are devoted to the study of pharmacology (including materia medica and practical pharmacy), pathology, bacteriology, hygiene, ophthalmology, medicine, surgery, obstetrics, gynæcoloy, medical jurisprudence, mental diseases, radiology, dermatology, infectious diseases, diseases of the ear, nose and throat, anæsthetics, dental surgery, vaccination and venereal diseases. The list of subjects specially for the final year is ever on the increase. The minimum period in which a student can qualify after matriculation is six and a half years, but usually it is much longer, about seven or eight years. There is need for a comprehensive survey of the whole field of medical edu-

cation in India with the object of framing a curriculum not too long and unwieldy, which is especially adapted to the needs of medical practice in this country. It should comprise the essentials of the fundamental sciences, which the medical man is called upon to practise in later years. As suggested by Dr. Barclay, all instruction in technique should be eliminated except for those who intend to specialise. At the same time, ancillary sciences, such as anatomy and physiology, should be taught in their relationship to practical medicine, and the existing gap between them should be bridged as far as possible. The student should have sufficient leisure to think for himself and imbibe all that he is taught.

The danger of specialisation, which Dr. Barclay refers to, is not imminent in India yet, for specialization is still in its infancy. The primary aim of medical education is to train general practitioners, who are the backbone of the medical profession. This training should be on the broadest lines possible, so that the product of our medical colleges is a man with a cheerful, sympathetic, and optimistic outlook on life who possesses the freshness and vigour of youth, an intellect which is ever keen to learn, is receptive, adaptable, critical, with a due sense of proportion, and not crushed by a lengthy, rigid and unwieldy curriculum, and by a long series of examinations.

Side by side with the question of undergraduate instruction, the problem of post-graduate medical education in India, as I have already mentioned, needs urgent attention. "If" as Dr. Barclay truly says, "a very broad basis of education is essential for critical appreciation of specialized knowledge," it is also true, that having once made the necessary provision for a broad basis of under-

graduate medical instruction, ample facilities should be available for training in specialized knowledge after qualifying. It is in post-graduate medical education, that our Indian universities are specially lacking. It is true, that in some centres as in Bombay special efforts have been made in this direction. Here the University has instituted a Diploma in ophthalmology, degrees of Bachelor and Doctor of Hygiene, Master of Surgery, and Doctor of Medicine. Quite a number of post-graduate students study for these degrees and diplomas. But much more remains to be done. The need is specially great for clinical courses in special subjects for the practising physician, who desires knowledge, but does not aspire to obtain post-graduate degrees and diplomas.

From the very commencement of his studies, the medical student should be made to realize the nature of his task in later years and the ideal of the profession to which he has the honour to belong. This is aptly described by R. L. Stevenson:—

"There are men and classes of men that stand above the common herd; the soldier, the sailor, and the shepherd not infrequently; the physician almost as a rule. He is the flower (such as it is) of our civilization; and when that stage of man is done with, and only remembered to be marvelled at in history, he will be thought to have shared as little as any in the defects of the period, and most notably exhibited the virtues of the race. Generosity he has, such as is possible o those who practise an art, never to those who drive a trade; discretion, tested by a hundred secrets; tact, tried in a thousand embarrassements; and what are more important, Heraclean cheerfulness and courage. So it is that he brings air and cheer into the sick

room and often enough, though not as often as he wishes, brings healing."

Thus, would it not appear that in order to train a man or a woman for the profession of medicine, we should employ the best of wisdom at our command?

But apart from all this, a society, such as the grant College Medical Society, has an important place in the education of the medical man. Plato said, that education is a life-long business. The doctor's education comes largely from his patients, books and journals. But a society lays the foundation for that unity and friendship which is essential to the dignity and usefulness of the profession. It offers a rare opportunity for the exchange of views, and in the words of the late Sir William Osler "helps to keep a man up to the times, and enables him to refurnish his mental shop with the latest wares." The Grant College Medical Society is the direct successor of the old Medical and Physical Society of Bombay, the oldest society of its kind in the Presidency, to whose deliberations the Grant Medical College largely owes its existence. Therefore this Society by virtue of its long traditions has a special mission in regard to the training of the physician. Let me conclude by reminding you of the famous words in the Epistle to the Hebrews:

"Let us hold fast the profession of our faith without wavering—and let us consider one another, to provoke into love and to good works: not forsaking the assembling of ourselves together as the manner of some is."

VI

RECENT DEVELOPMENTS IN MEDICAL EDUCATION IN INDIA*

The problem of medical education is receiving a great deal of attention at the present time. This is as it should be. The calling of medicine demands a long and arduous period of training and preparation. Medical education is the best type of liberal education that one can have. The medical course consists of a wide range of subjects and comprises a number of stages, through which a student has to pass before he can be vested with the responsibility of alleviating human suffering. The division of the course into a number of parts should not convey the idea that the individual parts consist of water-tight compartments. All parts are closely inter-related. As Sir Clifford Allbutt, Regius Professor of Physics at Cambridge used to say, several stages of medical learning are not a series of isolated reservoirs, but a series of tributaries, which flow into one large gathering stream. It is the task of the Universities and Medical Colleges to so arrange the courses of instruction that one stage leads logically to another, and gaps between them, which may be apparent, are suitably bridged. This integration of medical knowledge is essential at all times, but is specially so these days when owing to rapid advancement of our knowledge of medicine, specialization has become necessary, and there is danger that medicine may be split into small fragments. Specialization is a natural phenomenon, and has come ta stay, but

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*Reprinted from *Current Medical Practice*, Vol. 7, No. 6, pp. 439-443, June 1963.

we must take care that integration keeps pace with specialization.

We must also remember that medical education is a life-long business. It does not end with the passing of the final M.B.B.S. Examination and obtaining the medical degrees and diplomas. A physician has to keep on educating himself till the end of his days. A habit of self-education should be acquired in the medical societies and those working in the medical college from the early days. Later on, we receive this education from our patients, from medical journals, medical books and from contacts with our colleagues in the medical societies and those working in the laboratories and hospitals. Facilities should be provided for refresher courses in the colleges and hospitals, when we can get free for a time from the occupations, distractions and worries of normal life, and devote ourselves to reflection and study.

Social Factors in Medicine

We must consider the patient not merely as a disease, but as a human being. This implies that the physician should appreciate and face the realities of the social and environmental factors in relation to his patient. Man is a biological and social being and consequently the art of healing is both a natural and social science. The goal of medical education is to train physicians who are capable of dealing with all the health needs of the human beings. As Dr. Henry E. Sigerist rightly said, the picture society has of the ideal physician—the goal of medical education—is determined primarily by two factors, the social and economical structure of that society, and the technical means available to medical service at the time. The tendency hitherto has been to focus attention on the technical

means, but the modern trend is to strike a proper balance between the teachings of the physical and social factors of medicine. This means that the importance of factors in the patients' home, and community, which have a bearing on his illness and health, should be appreciated and suitably dealt with.

The student working as a clinical clerk in the hospital sees the patient in the ward nicely tucked in a comfortable clean bed and receiving a balanced diet, unless it is restricted according to his special needs. The young student often has difficulty in visualising that the same person, whom he sees in the hospital ward may come from a crowded home, which is poor and none too clean, and that his ordinary diet at home may be totally inadequate owing to his economic limitations, that there may be other persons in the house, who are ill—circumstances which have an adverse effect on the individual's health and peace of mind. It is not surprising, therefore, that the student does not become aware of the social aspects of disease, unless a serious effort is made by his teachers to impress upon him the importance of these factors.

There are three major aspects of disease—physical, emotional and social. They are intimately connected with each other. The medical student should learn to recognize and understand the social factors in every case and to evaluate them in relation to the medical problem facing him.

In order to understand the human being as he or she functions as a member of the society, the students need to learn the structure of that society, the pattern of urban and rural life, and the facilities offered by the Government and the community for the prevention and treatment of disease. He should know the role of various voluntary

agencies in the community-organization, and must learn how to utilize them for the purpose of meeting the health needs of the patient both in the rural and urban areas.

A knowledge of the social aspects of medicine is as important as the knowledge of Physiology and Pathology, and should be taught in the pre-clinical years, so that the student is prepared for its application later when he has to deal with patients. During the years of clinical training, the students should get opportunities to visit the homes of the patients. And subsequently when he holds internships and house appointments in the urban and rural areas, such opportunities could be further extended.

Facilities should be provided to medical students for participating in extramural activities, such as home care of the patients and urban and rural health units. They should be encouraged to make health surveys preferably in a Community Development of National Extension Block.

Medical Research

Another matter of vital importance is the promotion of medical research in the medical colleges, so that medical education is imparted in an atmosphere of research. This will inspire the students with the spirit of independent enquiry, and they will in due course make a contribution of their own and thus help to extend the boundaries of medical science. It has been truly said that "the memorizing and reproduction of factual data should not be allowed to interfere with the primary need for fostering the critical study of principles and the development of independent thought." I need hardly emphasise, that for the progress of medicine, research is most essential. The essential nature of research is however not in the subject mat-

ter so much as in the way in which it is carried out. If the investigations are to have a real meaning, they must be carried out according to the best scientific methods. It is the duty of the teachers in medical colleges to supply the necessary leadership in this work. There should also be suitable co-ordination between different departments of the college in dealing with problems, which have different facets and need to be investigated from different aspects.

It is of vital importance that in order to be a good research worker, one should possess certain essential qualities, namely an intelligent and independent attitude of mind, intense devotion to truth and a meticulous respect for detail. The universities and medical colleges contribute the very foundation of medical research. They provide an ideal climate for research and should be considered as the true nursery of research workers. As Sir Harold Heinsworth once said, "the spirit of research is to a university what morale is to an army."

The medical colleges in India, speaking generally, are functioning in an atmosphere, which is not in close relationship with the other departments of the university. This is a logical development of institutions which are connected with an affiliating type of university. There is need for a closer integration of the university departments of Chemistry, Physics, Biology, History and Philosophy with our medical institutions. After all, medical science is based largely on the application of the knowledge of physics and chemistry to biological phenomena, and so in investigation of many medical problems it may be necessary to obtain the assistance of pure chemists, physicists, biologists, etc. The Departments of History and Philosophy also come

into the picture in dealing with the history and philosophy of medicine and medical ethics.

Preventive Medicine

More and more stress is being laid in the course of instruction today on the importance of preventive medicine than ever before. And quite rightly so. It is painful to note, that in India the health conditions are still very unsatisfactory although improvement is slowly taking place.

Here there are three important factors, which need immediate attention, namely communcable diseases, environmental sanitation and nutrition. It is only by improving the environmental sanitary conditions and increasing the nutritional standards of the people, that it is possible to fight successfully the diseases which have been prevalent in the country for centuries. When all the communicable diseases have been controlled and the nutrition of the people improved, the energy and skill of the people will increase and they will thus exert themselves with greater effort and zeal and will bring happiness, peace and prosperity to the land. These are matters, which should be brought home to the students in their undergraduate days.

Contact Between Teachers and Students

Medicine is both an art and a science. A proper study of it requires a close personal contact between the teacher and the student. The teacher has an important duty to perform in this respect. There are certain things like quickness of perception, rapid collection and sorting out of a series of impressions, the exercise of intuition and tact and skill in obtaining history from the patient, making the diagnosis and prescribing treatment, a sympathetic approach to the patient, correct professional etiquette etc., which can best be learnt when a student

closely watches his teacher at the bed-side of the patient. Such things cannot be learnt from any text-book.

Medical Ethics

Throughout the whole course of instruction, special stress should be laid on the ethics of medical profession, and their due observance in daily work. The tenets of the Hippocratic Oath should be deeply instilled into the minds of the students, and they should be taught to practise medicine with a true spirit of service.

History of Medicine

It is imperative that we should teach history of medicine in all our medical colleges.

We are fortunate in possessing a fine heritage, which throws great responsibilities on our shoulders. Thomas Fuller once remarked, that it is the bounden duty of every one to better his heritage of birth or fortune, and where the father found glass, and made crystal, he urges the son to find crystal and make pearl out of it. We are lucky, that our culture is a composite one and our medical heritage very rich and diverse, and a happy blend of the ancient and modern modes of thought. It includes ancient Hindu, Buddhist, Egyptian, Greek, Roman, Arabian and Persian contributions to medicine, as well as its modern developments since the days of the Renaissance with which we have been connected owing to our connection with the Nations from the West, especially Great Britain. If Charaka and Susruta, Hippocrates and Galen, Rhazes and Avicenna, Vesalius and Harvey, Pasteur and Lister were alive today, I am sure they would say, that we should continue to make contributions to the knowledge of medicine and that the crystal which they have left to us, we should make diamond and pearl. We must not for-

get to imbibe all the lofty ideals comprising devotion to duty, steadfastness of purpose, charity, compassion and spirit of service, that they have handed down to us, apart from the knowledge of diseased conditions, their treatment and prevention.

Methods of Teaching

It was said by Karl Pearson once, that "the true aim of the teacher should be to impart an appreciation of method rather than knowledge of facts." Learning is facilitated by an appeal to the senses, specially, the auditory and the visual; but we learn best by doing a thing with our own hands. Apart from the traditional practice of lecturing, more and more stress is laid on visual aids such as lantern slides, film strips, pictures, charts, epidiascopes, models and specimens, cine films and even television. But, what is most important is the method of learning by actual practice, which consists of practical work in the laboratories and dissecting room, examination of patients, internships and preceptorships. Clinico-pathological and clinico-social conferences are also very helpful. We should remember, that the whole art of teaching is the art of awakening the natural curiosity of the mind and of showing how this can be satisfied, so that learning becomes an active and exciting experience.

Concluding Remarks

The First World Conference on Medical Education held under the auspices of the World Medical Association in London in 1953, wisely emphasised that no uniform pattern of medical education could be designed, to suit the needs in the different parts of the world, and that the scope and content of the curriculum require to be developed in each region on the basis of its major

health problems, and of the economic, social and health policies of the State concerned.

The aim of medical education should be to train a thinking man, so that he or she possesses adequate knowledge of the main subjects of the medical curriculum and is keen on acquiring additional knowledge, both theoretical and practical of any particular subject in which he is interested. This process of self-education should continue throughout life. But the essential thing is that he should develop a dynamic and keen desire to learn.

In order that the teaching should be of the required standard, we should have good teachers possessing the necessary talent and experience, so that they have an inspiring influence on the students under their charge. There is at present low teacher-student ratio in most medical colleges in India. This needs to be remedied.

The existing curriculum for the M.B.B.S. degrees is rather heavy. An attempt should be made to reach a compromise between the claims of different subjects and bring about integration and correlation between them. There is need to omit much of the unnecessary factual data in dealing with various disciplines and lay more stress on principles. In this country we consider examinations, as if they were the be-all and end-all of all education, and although we consider that this is not the right attitude, we have not yet found a suitable solution of the problem. It is necessary, that the student should be given due credit for his day-to-day work including the tests, which he has to undergo in his class. This will create in him greater interest in his university examinations, so that there will be a definite reduction in the failures, the number of which at present is very high.

An attempt should be made to arrange group discussions and seminars so as to provide the student with greater opportunities for exchange of ideas. Integration between different subjects is vitally important. During the preclinical years, demonstrations to students on suitable clinical cases in the wards would be useful in bridging the gulf between the basic and clinical sciences.

It is necessary to instil into the minds of the students, that after a period of evolution, medicine has reached today a stage when its scope is more comprehensive than it was ever before. It is not merely an art of prescribing pills, powders, mixtures or injections or even performing a surgical operation when necessary. These things are of course necessary, for they are an essential part of our armamentarium. But the aim of medicine is to offer medical relief, both domiciliary and institutional, to every citizen in the land, on the widest possible scale. All the facilities required for the treatment and prevention of diseases as well as for the promotion of positive health should be provided for all, irrespective of their ability to pay for them. We also now study disease and ill-health in relation to social and physical environment. In order to study the scope of medicine in any country, we must study its social, cultural, economic, scientific and historical aspects. Such study should include the practice, teaching and research in medicine in all its roots and branches on the widest possible scale.

VII

PHYSIOLOGY IN INDIA*

For a scientific worker in India to preside at a Section of the Indian Science Congress is indeed a signal honour. I wish to express my profound appreciation and gratitude for the great honour done to me by my colleagues in inviting me to preside over the Section of Physiology this year.

This Section is still in its infancy. Today, in fact, we celebrate its first anniversary. Its inception last year was a recognition of the fact, that the Science of Physiology existed in India, and that the special workers in this field had achieved enough importance to deserve a separate Section of their own. This recognition, tardy and belated though it be, implies that Physiology is not to be regarded merely as a handmaiden of Medicine, but as an independent science of fundamental importance. This marks a distinct and vital stage in its history in India, and makes one naturally think of its past and its future in this country. I have, therefore, chosen 'Physiology in India' as the subject of my address. To trace successfully the evolution of any science in any country is a difficult task; but to trace the evolution of Physiology in India is all the more difficult, in view of peculiar conditions here. In the course in this address, I shall content myself by dealing with certain factors only, which are of interest to us, and shall undoubtedly omit much, which might have made less sketchy a sketch necessarily imperfect.

*Presidential address delivered at the 24th Indian Science Congress (Section of Physiology) held at Hyderabad, Deccan in January 1937.

Reprinted from the *Patna Journal of Medicine*, Vol. XII, No. 2, April 1937.

Physiology in India: The Past

In India, as elsewhere, the history and growth of Physiology are inseparably connected with those of Medicine. Indeed, Medicine is the mother of all branches of Natural Science. Chemistry, Physics, Botany, Zoology, Anatomy, Pathology, and Bacteriology have all arisen from Medicine. Mankind is always in search of better and better means for the maintenance of health and cure of disease. This has resulted in new lines of thought and new methods of work from time to time, thus creating new sciences. Medicine has been practised and taught in India from times immemorial. The system of Medicine which is indigenous to the soil is the Ayurvedic. Subsequently with the advent of the Moslems, the *Unani* or the Græco-Arabian system was introduced. This was based on the science of Greece and Egypt and was developed under the enlightened patronage of the Khalifas of Baghdad. The principal service of Islam to Medicine was the preservation of the Greek culture. These two systems of Medicine were the only ones taught and practised in India up to the time it came into contact with the nations of the West. They still exist and command much influence. In any system of Medicine, some hypothesis as regards the normal functions of the different organs of the body is essential in order that morbid processes occurring in different diseases may be given a rational explanation. You are no doubt aware, that the Humoral Physiology of the Ayurvedic Medicine pre-supposes three principal 'humours' or fluids in the body, namely 'Vata' or wind, which has its seat between the feet and the umbilicus; 'Pittha', between the umbilicus and the heart; and 'Kafa' between the heart and top of the head. Health is associated with the normal

condition of these humours; disease with their derangement. The Unani system was noted specially for its chemistry, which had its origin in Arabia. The processes of distillation, filtration, sublimation, water baths, etc., were introduced there. The Physiology of this system was mainly that of Galen. Charaka and Susruta, the great physicians of the ancient Ayuvedic Medicine, and Rhazes and Avicenna, the famous Persian physicians who practised the Unani system, are the great master-minds of Medicine of the past, and rank with Hippocrates, the famous Greek physician of antiquity. It is not my purpose here today to discuss and appraise the Physiology contained in the ancient system of Medicine in India. All I wish to point out is, that the theories and dogmas held by the ancients are not to be despised. On the contrary, their achievements deserve praise. They served their purpose admirably in their day. Each age must make the best of the knowledge it possesses. Who can tell what our successors two thousand, or even two hundred years hence will think of us for the views and dogmas, that we profess today?

It is more to my purpose to describe briefly to you the steps that led to the introduction of Modern Medicine and Physiology into India. This movement started in the early part of the 19th Century. At this time, instruction in Ayurvedic and Unani systems of Medicine was imparted in the Sanskrit College and the Madrassa in Calcutta. It was however in 1822, that the first Medical School was established in the city. A similar Medical School was started in Bombay in 1826. It functioned for 6 years and was abolished in 1832. Credit is mainly due to Lord William Bentinck, the Governor-General, for initiating

higher medical education in India. He appointed a Committee in 1833 for improving the Medical School in Calcutta, and the education imparted there. The members of this Committee were Surgeon John Grant, Apothecary (Medical Storekeeper) to the East India Company; J. C. C. Sutherland, Esq., Secretary to the Education Committee; C. E. Trevelyan, Esq., Deputy Secretary, Political Department; Assistant Surgeon Spens of the Bodyguard; Assistant Surgeon M. J. Bramley, Assistant Marine Surgeon, and Babu Ram Komal Sen. The deliberations of this Committee have had a most profound effect on the future course of medical education in India. In October 1834, the Committee submitted a lengthy report and made several recommendations for the improvement of the Calcutta Medical School. It is interesting to note that on one point the members of the Committee were divided, namely whether the instruction should be imparted in an Indian Vernacular or in English. The anglicists finally prevailed over the orientalists. These recommendations were approved. The result was, that the Medical School was abolished, and the medical classes at the Madrassa and the Sanskrit College were also done away with. The old order changed yielding place to new. The foundation of a new Medical College of Bengal was sanctioned in 1835. The original staff of the College consisted of Drs. M. J. Bramley and H. H. Goodeve.

In Madras, when Sir Federick Adam was Governor, a Medical School was established in 1835. It was of the same standard as the Medical School founded in Calcutta in 1822, rather than the College founded in 1835. The original staff consisted of Surgeon William Mortimer and Assistant Surgeon George Harding. In 1847 the Madras

Medical School was raised to the Standard of the Medical Colleges in Calcutta and Bombay, but its name remained unaltered until 1st October, 1850.

In Bombay, it is to Sir Robert Grant, who was Governor from 1835 to 1838, that the credit for the introduction of higher medical education is entirely due. Soon after he became Governor he directed his attention to this subject. In 1837 the Medical and Physical Society of Bombay was organized and in the same year the Government directed its Managing Committee to look into the subject of medical education. A former Medical School, one of the earliest of its kind in India, had flourished here for 6 years and had been abolished, as already mentioned, in 1832. This was rather disheartening, and so the movement for the establishment of a new institution moved rather cautiously but surely. After consulting various bodies, Sir Robert Grant wrote to Calcutta, the then Capital of India, advocating enthusiastically the establishment of a Medical College in Bombay. The proposal was approved by Lord Auckland's Government. But before this information reached Bombay, Sir Robert Grant died on 9th July, 1838. At a public meeting held on 28th July, 1838, at the Town Hall in Bombay, it was decided that as a mark of respect to the memory of the late Sir Robert Grant and in gratitude for his public services, a Medical College so ably planned by him be established and bear his name. The institution was thus named *Grant Medical College*. The cost of the building was defrayed equally by public subscription and by contribution from the Government. The foundation-stone of the edifice was laid on 30th March, 1843, by the Lord Bishop of Calcutta. It was completed in October 1845. The College is associated with the Jamsetjee Jeejee-

bhoy Hospital, named after Sir Jamsetjee Jeejeebhoy, who offered a sum of one lac of rupees, provided the Government contributed an equal sum, for the estiblishment of a Hospital. The foundation-stone of the Hospital building was laid on 3rd January, 1843, and it was opened for the reception of the sick in 1845. The College and Hospital being thus ready, instruction began in November 1845. The original members on the staff were Drs. Charles Morehead (the Principal), John Peet, and H. Giraud. With this institution I have the honour of being associated for some years now. If I have described its origin at some length, my excuse is that I am better acquainted with it than with any other Medical College in India.

This is briefly the history of the establishment of the three oldest Medical Colleges in India, where the teaching of Modern Medicine and Physiology first started. Subsequently other Medical Colleges of a similar kind were established, namely the King Edward Medical College, Lahore (1860), King George Medical College, Lucknow (1912), Lady Harding Medical College, Delhi (1916), Carmichael Medical College, Calcutta (1916), Medical College, Vizagapatam (1923), Prince of Wales Medical College, Patna (1925), Seth Gordhandas Sunderdas Medical College, Bombay (1926), and Medical College, Rangoon (1924).

There are Medical Colleges, besides, at Hyderabad (Deccan) and at Mysore, and numerous Medical Schools in all the Presidencies and Provinces of India. Time would not permit me to narrate the interesting history of all these institutions. But one thing is certain. With the increase in the number of Medical Colleges and Schools there has resulted a marked expansion of medical educa-

tion throughout the country in recent years. And side by side with this, the knowledge of Physiology has also spread. In most of the Medical Colleges in the past, the Chair of Physiology was often held by one, who also taught some other subject, such as Medicine, Pathology or Anatomy. Subsequently it was made an independent Chair. In later years, it has been made a whole-time Chair, the Professor being debarred from medical practice.

In Bombay, Physiology was originally known as 'Institutes of Medicine', a designation by which it was known till lately in the Scottish Universities. It was taught at first by Dr. Charles Morehead, the first Principal of the College, who was Professor of the Institutes and Practice of Medicine.

We have had some excellent and renowned teachers of Physiology in India in the past, such as Dr. Charles Morehead, Col. Meyer, and Col. Rose Hutchinson in Bombay, Col. McKay in Calcutta, Col. Donovan in Madras, and Dr. Caleb in Lahore. In later years, with the establishment of wholetime Professorships in the subject, Physiology has entered a new phase, and now we witness a marked increase in the output of original research work from the physiological laboratories in all parts of India.

It is no longer a subject of the medical curriculum only, for now several Universities in the country grant B.Sc. and M.Sc. degrees in Physiology. It is also an encouraging sign, that the subject is taught not merely in Medical Colleges but also in Science Institutes of certain Universities, such as Calcutta. The movement has even spread to the schools, and Physiology is one of the subjects that can be taken for the Matriculation Examination of most Universities in the country.

The best feature of Physiology in India is that the physiological laboratories here are, speaking generally, very well equipped. Hitherto, they have directed their attention more to teaching than to research. In 1928, the late Sir Walter Fletcher, an eminent physiologist of the Cambridge School, who was then Secretary of the Medical Research Council in England, visited the physiological laboratories in Grant Medical College. After very careful inspection, he turned round to me and expressed great pleasure at what he described as *'the latest edition of Foster in India.'* What is true of the laboratories in Grant Medical College is also true of laboratories in other parts of India.

Physiology in Europe

Speaking of Foster reminds us of the fact, that Physiology in its modern sense is a contribution that the West has made to the East. In order to get a correct perspective of its position in India, it is essential to consider its position in Europe and especially in England, with which we are primarily concerned.

In an address delivered in January 1901 on 'Medicine in the Nineteenth Century's before the Johns Hopkins Historical Club at Baltimore Sir William Osler said: "The study of Physiology and Pathology within the past half-century has done more to emancipate Medicine from the routine and thraldom of authority than all the work of all the physicians from the days of Hippocrates to Jenner, and we are as yet on the threshold." What was this remarkable development in Physiology in the latter half of the 19th Century, which brought about such a revolution in Medicine? The answer to this question takes us back to the middle of the 16th Century.

In the year 1543 Andreas Vesalius, Professor of Phy-

siology at Padua, published his classical and epoch-making book '*Fabrica Humani Corporis*,' which once for all abandoned the Galenic tradition, which had flourished in Europe for 1,400 years. Hippocrates (460–370 B.C.), the ancient Greek physician, a direct descendant of Aesculapius, is regarded as the greatest physician of antiquity. He believed that health and sickness are due to such factors as seasons, climates, waters and soils, food and exercise, and that the primary seats of disease were the four humours—blood, phlegm, yellow bile, and black bile. The merit of his work is, that he advocated that a knowledge of Anatomy, Physiology, and direct clinical observation of the patient are essential for a knowledge of Medicine. He introduced scientific spirit and ethical ideas into Medicine. Then came Galen (131–201 A.D.), another Greek physician who practised in Rome. He was the greatest Experimental Physiologist before William Harvey. He elaborated a system of Humoral Physiology and suggested that spirits or '*pneuma*' penetrated all parts of the body. He preached, that the blood received 'Natural Spirits' in the liver, and 'Vital Spirits' in the left ventricle of the heart, which were converted into 'Animal Spirits' in the brain. He 'proceeded to explain everything in the light of pure theory, thus substituting a pragmatical system of medical philosophy for the plain notation and interpretation of facts as taught by Hippocrates. The effect of this dogmatism and infallibility upon after-time was appalling'. (Garrison.) During the Middle Ages neither Physiology nor Medicine made any progress whatsoever. The reason, as Sir Michael Foster says, was that 'the Church held the gates of learning and they who entered were bidden to tread her path and hers alone. Her methods became the

methods of all scholars. Under her guidance, the written word took the place of the made world. The pursuit of truth ceased to be the looking into the phenomena of nature and for the seeking for the reason why; it narrowed itself to asking what the teachers taught. The method which had proved triumphant in the search after things spiritual was taken to be the method in all enquiry and biological enquiry was no exception. As spiritual truths were learned by the study of the revealed word, so anatomical and medical truths were to be sought for, not by looking directly into the body of man, not by observing and thinking over the phenomena of disease, but by studying what had been revealed in the writings of Hippocrates and Galen. As the holy Scriptures were the Bible for all men, so the works of the Greek and Latin writers became the Bible for the anatomist and the doctor. Truth and science came to mean simply that which was written, and enquiry became mere interpretation.'

In '*Fabrica Humani Corporis*,' Physiology and Anatomy are beautifully blended together. It is based on the author's own observations made by dissection of the dead body. In the revival of learning, which took place during the Renaissance, Andreas Vesalius (1514–1564) was the greatest master-mind in European Medicine after Galen. There are other notable names belonging to this period, such as Eustachius (1524–74), Columbus (1516?–1559), Fallopius (1523–62); and Fabricius ab-Aquapendente (1537–1619), who was Harvey's teacher at Padua.

The next great event was the advent of William Harvey (1578–1657), who was the greatest name in Medicine in the 17th Century. He is rightly regarded as the founder of Modern Physiology. He was born at Folkestone in Kent

and studied at Cambridge and Padua. At the latter place he imbibed the tradition of Andreas Vesalius. He was the discoverer of the circulation of blood which he described in his classical book *'De Motu Cordis'*; and his dictum 'Omne vivum ex ovo' based on embryological researches is famous. His true greatness, however, consists in introducing the experimental method in physiological investigations. This was a great contribution, which has had a profound influence on Modern Physiology and Medicine. Prior to this, Physiology was the playground of numerous theories, mostly fantastic and obscure. He pulled it up from the quagmire of dogmas, and gave it a respectable position among the sciences. Since then, it has begun to breathe freely. A little later, after the discovery of the compound Microscope, important microscopic discoveries were made by Loewenbock (1632–1732), Malpighi (1628–1694), and Swammerdamn (1637–1658).

In the 18th Century, we come across another great imposing figure, Albrecht von Haller (1708–1777), a master-physiologist, who for the first time put together an enormous amount of facts, systemized and harmonized them in his monumental work *'Elementa Physiologiae Corporis Humani'*. He raised Physiology to the status of an independent science. The great discoveries in Chemistry and Physics during this period had a profound influence on Physiology, and men searched for a physico-chemical explanation of vital phenomena. It was at this time, that Electro-Physiology had its origin. Luigi Galvani (1737–1798) of Bologna discovered that electricity is produced by the living animal body, especially by nerves. Alessandro Volta (1745–1827), Professor at Pavia, showed that a muscle can be thrown into tetanic contraction by repeated electric stimulation. The isolation of Oxygen by Joseph

Priestley (1733–1804) and of the respiratory interchange of gases in the lungs by Laurent Lavoisier (1743–1794) destroyed the old Phlogiston theory for all time. Lavoisier also showed, that combustion and respiration are analogous processes, the end products of each being the same.

In the 19th Century Physiology, the greatest figure is Johannes Müller (1801–1858). He was an indefatigable investigator, with a fine critical mind, who brought his profound knowledge of Physics, Chemistry, Anatomy, Zoology, Embryology, and Histology to bear on his physiological investigations. While investigating individual problems, he always kept his eye on the larger problem of life as a whole. The physiological knowledge of his time was incorporated by him in his *Handbuch der Physiologie des Menschen*, a model text-book of its kind. Like Haller's *'Elementa Physiologiae Corporis Humani'* it is a great classic, full of facts and original ideas. He was in a true sense the founder of Scientific Medicine in Germany, and had amongst his pupils men like Schwann, Henle, Kollicker, Virchow, Du Bois Reymond, Helmholtz, and Brucke.

We find Physiology developing along two main paths during the 19th Century. In the first place, Wohler, Liebig, Voit, Pfluger, Zuntz, Hoppe-Seyler, Hammersten, Bunge, Halliburton, Baumann, Kossel, and others led its development on the chemical side, so much that Physiological Chemistry became more and more independent. It has latterly been designated *Biochemistry* and tends to part company with the parent science. Secondly, Carl Ludwig, Helmholtz, Du Bois Reymond, Marey, and others led its development on the physical side. The introduction of the graphic method by Ludwig became the favourite method of investigation by subsequent workers. Animal experiments

became more and more common. Operative Physiology bore rich fruits in the hands of the celebrated French physiologists, Magendie and Claude Bernard, and latterly in the hands of the great Russian physiologist, Pavlov.

Physiology in Great Britain

And now let us direct our attention particularly to Great Britain, which undoubtedly is the fountain-head of Physiology as well as Medicine in India. The founder of Modern Physiology and Medicine in the 17th Century was an Englishman, the great William Harvey. Subsequently Stephen Hales, John Hunter, and William Hewson made important contributions to the science. But in the first half of the 19th Century, England was far behind Germany and France in this respect. There was no one there at the time, who could rank with Johannes Müller, Carl Ludwig or Claude Bernard. The reason was that no one took up Pure Physiology there as a vocation. The state of affairs there is described admirably by Sir Edward Sharpey-Schafer in his *History of the Physiological Society*. Any surgeon or physician was considered competent to teach the subject in the Medical Schools. Schafer says that in one place only — University College, London — was a lamp kept burning; the lamp was that of William Sharpey, who was appointed Professor of General Anatomy and Physiology there in 1836. Although he himself made no great discoveries in Physiology, British Physiology owes a deep debt of gratitude to William Sharpey (1820–1880), in that he inspired the love of the science in those who worked with him, encouraged others to undertake research work, and founded the Modern School of Physiology in England, of which England now is so justly proud. The

developements at University College were of the utmost importance. Let us follow them.

Michael Foster, an old student of University College, was persuaded by Sharpey to give up his medical practice at Huntingdon and come to University College to teach Physiology with the title of Professor of Practical Physiology. According to Schafer, this appointment of Michael Foster proved a decisive factor in the history of Physiology in Great Britain.

Now, at Cambridge fortunately at the time there was a far-sighted Professor, who was anxious to improve medical education there. This was Professor George Murray Humphry, Professor of Anatomy in the University. He was very keen for the establishment of Physiology there. As a preliminary step he persuaded the authorities of Trinity College, Cambridge, to establish a Praelectorship in the subject in the College. Michael Foster, then at University College, was invited to occupy the position. He did so in 1870, and at once set seriously to work, and attracted a number of able and keen young men around him. He became Professor of Physiology in the University in 1883. He was a great teacher. Amongst his pupils were men like Francis Maitland Balfour, Milnes Marshall, Sidgwick, Ray, Francis Darwin, Vines, Walter Gaskell, John Newport Langley, Charles Scott Sherrington, Joseph Barcroft, Henry Head, Charles Scott Roy, John George Adami, and George Romanes. It may be of interest to note that Sir Charles Sherrington carried the tradition of the Cambridge School successively to St. Thomas's Hospital, London, to Liverpool, and finally to Oxford.

Foster retired in 1903. He was succeeded by Langley. On Langley's death in 1925, Joseph Barcroft was appointed

Professor of Physiology at Cambridge. He, by the grace of God, is still occupying Foster's Chair there. Foster, Langley, and Barcroft, the leaders of the Cambridge School, have influenced the development of Physiology not only in Great Britain but in all parts of the world.

At University College, London, Burdon Sanderson succeeded Michael Foster, when the latter went to Cambridge. Subsequently he succeeded Sharpey as Professor, when the latter retired in 1870. Edward Sharpey-Schafer was appointed Assistant to Burdon Sanderson in 1874, and subsequently became Professor in 1884, when Burdon Sanderson went to Oxford as Wayflete Professor of Physiology. In 1899 Schafer went to Edinburgh and in his place Ernest Starling became Professor at University College. He was succeeded by Archibald Vivian Hill, who, when appointed Foulerton Professor of the Royal Society, was succeeded by Lovatt Evans, who I am happy to say now occupies Sharpey's Chair at University College.

At Oxford, Burdon Sanderson was succeeded by Francis Gotch, and he in turn by Sir Charles Sherrington. On Sherrington's retirement recently John Mellanby has gone from St. Thomas's Hospital to Oxford as Wayflete Professor.

University College, London, Cambridge, Oxford, and Edinburgh have been the nuclei of British Physiology during the last 50 years. They have been responsible for the development of Physiology in Great Britain, and the British Empire generally, not to speak of other countries. Their influence has spread to India also. In recent years, the subject has received a great impetus. More and more workers are being attracted towards it.

Such was the development of Physiology in Europe and

especially in Great Britain; and such was its position in India.

Physology in India : The Future

My object in addressing you to-day, however, is mainly to direct your attention to the future of Physiology in India rather than its past. The purpose of looking back on the past is to seek guidance as to the lines of future effort. It should make us redouble our efforts. Physiology has a brilliant future in this country. There are many problems in the solution of which the guidance and help of the physiologist are indispensable. The fields for research work in Pure and Applied Physiology in India are vast. There is urgent need for more workers.

Permit me to mention some of the problems in Physiology, which we in India can profitably take up for investigation.

(*a*) *Physiology and Social Service*

I have always held the view that knowledge of Physiology is of immense value in dealing with many social problems. The value of physiological research to the 'labouring' life is inestimable. Sir Leonard Hill and the late Professor J. S. Haldane have played a great part in applying the discoveries of the laboratories to the workshop and the mines.

The physiologist was formerly regarded as rather an unpractical theorist, who was more interested in the twitchings of frog's muscles than in affairs of men and women in this world. But this is not so today. We have now realized that Laboratory Physiology is not an end in itself, but a means by which we can understand the larger problems of life, and especially human life on this earth.

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A great believer in the role of Physiology in the welfare of a nation was the late Sir Walter Fletcher, by whose premature death in 1932 British Physiology suffered a great loss. In a national broadcast address, he once said 'We can find safety and progress only in proportion as we bring into our methods of statecraft the guidance of biological truth.' This is perfectly true.

It is rather a melancholy fact, that in proportion to the knowledge of Physics and Chemistry, the knowledge of biological sciences in the country is comparatively meagre. And yet in considering ways and means to bring about social reconstruction and physical well-being of the people, a knowledge of Physiology is indispensable.

In matters such as factory and mine legislation in the interest of the workers, pure food laws, maternity and child welfare work, antenatal and postnatal care, marriage laws, physical fitness, and knowledge of personal hygiene especially in regard to rest, exercise, hours of work, diet etc., who can deny that a knowledge of Physiology is not a *sine qua non*?

(*b*) *Nutrition*

The subject of Nutrition is engaging much attention in India today. And quite rightly so. I hope I am not exaggerating when I say, that easily quite one-half of Physiology comprises the topic of bodily nutrition. It is undoubtedly the special domain of the physiologist, and it is he who has made the largest contributions to our knowledge of the subject.

With the birth of Chemistry in the 17th Century and introduction of the experimental method, Nutrition began to assume the shape of a real science. Liebig was the founder of modern Nutritional Physiology. He and his pupil

Voit, and Rubner (who was Voit's pupil) established the laws of quantitative metabolism. They made it an exact Science. Rubner demonstrated the important principle of conservation of energy, which holds good in Mammalian Physiology. With the aid of the Respiration Calorimeter, Atwater, Benedict, Magnus-Levy, and Lusk worked out the detailed application of the principles already established.

With the increase in the knowledge of Chemistry and Physiology, we have learnt a great deal more about food and its use in health and disease.

During the last 25 years or so, very important investigations have been carried out in the domain of the qualitative side of dietetics, especially the biological value of different proteins of animal and vegetable origin, and of the special significance of the mineral constituents of the diet. To Sir F. G. Hopkins, Professor of Biochemistry at Cambridge belongs the credit for the discovery of *Vitamins*, which play such an important part in Nutrition. Our knowledge of these so-called 'accessary food factors' is increasing rapidly.

In opening a discussion in the section of nutrition at the Annual Meeting of the British Medical Association at Oxford in 1936, Major-General Sir Robert McCarrison, C.I.E., M.D., I.M.S. (Retd.), who did important research work on nutrition in India, discussed the *contacts*, which the newer knowledge of nutrition has established. He quite rightly said, that these contacts were with Medicine, Bacteriology, Pathology, Obstetrics, Gynæcology, Surgery, Anatomy, Physiology, Biochemistry, Psychological Medicine, Neurology, Orthopædics, Radiology, Oto-rhino-laryngology, Tuberculosis, Dermatology, Therapeutics, and

History of Medicine. In the opening paragraph he said, that he hoped that on future occasions, the work of this section would not be limited to physiological, biochemical, pathological, and medical aspects of the subject, but that it would include those that are veterinary and agricultural.

I am very happy to say, that the contact of nutrition with the veterinary and agricultural sciences that he desired is being established in India at this Session of the Indian Science Congress by a joint session of these two sections.

The subject of Nutrition in India needs to be investigated from many points of view. To the physiologist it offers great opportunities for original research work. I trust many workers would be attracted by it, for the knowledge that is gained will be of immense benefit to our countrymen.

(c) *Racial and Anthropological Physiology.*

It is interesting to note, that there is a tendency amongst workers in India to investigate normal physiological constants here. Data have been obtained in regard to the various constituents of the Blood, Blood-pressure, Vital Capacity of the Lungs, Basal Metabolic Rate, etc. This information is of the utmost value. Thus:—

(i) It would indicate if the normal data obtained here differ in any way from those obtained from inhabitants in European countries.

(ii) It would throw light on any racial or environmental variation that may occur. We shall thus have a basis for Racial and Anthropological Physiology, which really is a very important branch of Human Physiology, and has not received sufficient attention hitherto.

(iii) These figures would also help the practising physician, as they will furnish him with the necessary

information in regard to the deviations from normal that occur in different diseases in the case of inhabitants of this country.

(*d*) *Adaptation to Tropical Climate*

Another fruitful line of physiological investigation is to ascertain the factors concerned in the adaptation of the human being to tropical conditions. A certain amount of work on the subject has been done in recent years, but the whole mechanism is not yet clearly understood. Undoubtedly here as elsewhere the famous dictum of Claude Bernard 'La fixite du Milieu interieur est la condition de la vie libre' so ably discussed by Sir Joseph Barcroft in his well-known book *Features in the Architecture of Physiological Function*, holds good. It would be of great interest to collect more data, regarding the reactions of the human body to variations of atmospheric temperature and humidity, to correlate them, and to arrive at a comprehensive explanation of them.

It will be seen, I trust, that the effects that are observed result from the cumulative action of a number of factors, each of which alters in a lesser degree, and like any other adaptation, the adaptation to the tropical climate is an 'integration' (Barcroft).

I have jotted down at random some of the problems, that can be taken up by us for investigation. But in research work, the important thing is to be guided by one's own inclinations. The essential thing is to acquire love for the science, to study it for its own sake, and to make investigations with the object of discovering scientific truth, without necessarily any idea of the *applications* of these discoveries.

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Physiology in the Medical Curriculum

My remarks here would be very incomplete if I did not make a reference to the position of Physiology in the medical curriculum. In the preclinical group of subjects Physiology occupies a position of the first rank. And rightly so, for unless one knows the normal functions of the body, how is one to understand the deranged function associated with disease? There has been a great deal of discussion in recent years in England and elsewhere regarding the scope and function of this preclinical instruction. The complaint is that too much stress is laid on 'Pure' Physiology, and not enough on 'facts' which are of clinical importance, that the student is required to possess knowledge of vast amount of 'details,' which are of no use to him in the clinical work afterwards, and that the outlook of the student when he enters the wards is not sufficiently orientated towards the clinical work he is about to begin. The teachers of the Pre-clinical Subjects report, that their business is to impart a scientific and not a vocational training. For a super-structure of Applied Science a solid foundation of Pure Science is necessary and it is futile to talk of 'applications' of Physiology to the first and second year's students, who are completely out of touch with Hospital work. In my opinion the two opposite points of view can be reconciled. The wide gulf that separates the preclinical and clinical sciences should be bridged, and there should be continuity of instruction in preclinical sciences in the clinical years.

May I invite your attention to the Report published in 1935 of the Conference of the Representatives of the Universities of Oxford, Cambridge, and London, Royal College of Physicians of London, Royal College of Surgeons

of England, and the Society of Apothecaries of London on the Medical Curriculum, whose Chairman was Lord Dawson of Penn. The revision of physiological teaching and its correlation with the clinical part of the curriculum are admirably discussed there. But to my mind, the most important thing is to show patients to the students while receiving instruction in Physiology, in order to demonstrate the derangement of function that has occurred. 'While it is essential,' says the Report, 'that the student should become acquainted with laboratory methods of scientific research, he should himself make experimental observations and should be trained to carry out accurate determinations as well as careful dissections, the relevancy of these requirements to his subsequent study of the living human body should not be allowed to escape his notice. The normal function of an organ can be described and observed in the course of physiological teaching, but it would form more permanent associations in the student's mind if variations from the normal could, at the same time, be demonstrated in the living human subject. Knowledge of the normal activities of the circulatory system observed in an animal or in normal man is amplified in a valuable way when compared with the results of a defect of the circulatory mechanism in man; the comparison not only reinforces memory and stimulates criticism but excites attention and interest. The demonstration of a hemiplegic patient will teach a student many facts about the physiology and anatomy of the pyramidal tract which cannot be learned in any other way'.

I trust, the Universities in India will appreciate the truth of this and will revise their curriculum accordingly.

We are all very glad, that the Royal College of Surgeons

of England has arranged to hold the Primary F.R.C.S. Examination in India. It was held for the first time in Madras in 1935, in Calcutta in 1936, and will be held in Bombay in 1938. This has already given a great impetus to the study of Physiology in all the Medical Colleges. Passing the Primary F.R.C.S. Examination in India is a great help to those who aspire to get the fellowship of the Royal College of Surgeons of England. We are very thankful to the authorities of the Royal College of Surgeons for this. And we are specially grateful to Major-General Sir Cuthbert A. Sprawson, Director-General, Indian Medical Service, through whose efforts the proposal achieved practical shape.

Concluding Remarks

I have briefly placed before you some aspects of *Physiology in India*. It came to India in the thirties of the last century with the introduction of Modern Medicine. You will observe, that it was planted on this Eastern Soil at a time when it was not in the very flourishing state in Great Britain. It has made slow but steady progress and we can all look to the future with hope and confidence.

Considering the great advances in Physiology during the last 4 or 5 decades, Osler's remarks, which I have already referred to, namely that the 'study of physiology and Pathology within the past half-century has done more to emancipate Medicine from the routine and thraldom of authority than all the work of all the physicians from the days of Hippocrates to Jenner; and we are as yet on the threshold' is as true today as it was in January 1901 when it was first made. In order to escape from empiricism and legitimately to claim the status and dignity of a science, Medicine must have Physiology as its *basis*. In order that

Physiology and Medicine may serve each other, it is as much imperative for physiologists to teach and investigate Physiology, as for the physicians to apply it to Medicine. But Physiology has other aims of its own. Some of the greatest discoveries in Physiology in recent years have been made by men, who had no medical training whatsoever. It has flourished most in those Universities where it has led an independent existence like Physics and Chemistry. Although the ultimate aim of all sciences is the welfare of mankind, — and this is perhaps true more of Physiology than of any other science — the immediate aim of any scientific endeavour must be the discovery of *truth*, irrespective of its possible applications.

This common aim brings all the scientific workers together, breaking down all barriers of race, nationality or creed. Thus it is one great potent instrument for the promotion of international goodwill, friendship and peace in the world.

Permit me to convey to you some messages of greeting and encouragement I have received from our colleagues abroad. Professor A. V. Hill, F.R.S., says:—

'If Science had no other purpose at all, no other result, it would probably be worth while for ordinary people to encourage it because of this international quality. Collaboration between different races seems to be far easier in scientific matters than in any others: perhaps because there is a court of appeal, viz. nature, which will settle disputes by experiments, and opinion and emotion are not the only guides. I am often astonished when I realise how far my only circle of friends and collaborators is international. It never occurs to one that they are of a different race or nation. They are just citizens of the Scientific Community.

India is well on the way. In some subjects, particularly in Physics and Mathematics, Indians are already collaborating very effectively with the rest of the world. Indian Scientists are beginning to be known in person and by their work, in all the countries of the world. You must see, that this becomes true also of physiology—"intellectually respectable"—so that men of really first-class ability will be attracted to it. At Cambridge, as you know, Physiology is just as "respectable" as physics: it is certainly just as difficult as Physics. Claim for it independent and honourable place, such as Physics has: do not let it be just a handmaiden (as the old saying was) of Medicine. Physics is not the handmaiden of Engineering. If it had been, Engineering would be in a bad way, for modern Engineering depends upon physical knowledge and Physics would have made no progress, if it had been the handmaiden of any other Science or Art. Independence and an honourable position are required, and if you can help to give Physiology in India these, you will get first-class youngster in to join it. A danger is that no man may be allowed to hold any place of importance in Physiology unless he has a medical degree. Avoid this tradition like poison. It means, that you will miss many of the ablest people of all—your Pasteurs, Langleys, Barcrofts, Cannons, Baylisses, Howells, Bronks, Lucases, Mineses, Kroughs, Lapicques. We shall look forward in England to seeing your able young men working with us: be sure that they *are* able before you send them, or they will waste their time and ours. Lim, the Chinese physiologist, asked me if I would have a pupil of his to work with me. I said, "Yes, if you can send me a really good one. It's a waste of time otherwise." He sent me his best, T. P. Feng, who is so good that I put him as high as any one I have ever had (and

that is pretty good). It is quality not quantity or numbers, which counts in Physiology. All men are not equal — one Rutherford is worth 100 ordinary physicists; one Pavlov produced more effect than 10,000,000 ordinary Russians in winning respect for his country. So guard and watch for and nurse the able youngster, and make things easy for him, and let him have as much independence as he can bear: and then send him out to see how things are done here or elsewhere. He will make friends, he will win respect for his ability, he will aid in establishing in India also brotherhood which is superior to race, religion, politics, disturbances, even to scientific differences of opinion — the international brotherhood of scientific people.'

Professor E. D. Adrian, F.R.S. (Cambridge), sends a message of most cordial goodwill and says:—'It is a great pleasure to think of the great scientific activity in India today and of the reunion of the scientists which is foreshadowed by the announcement of the Congress. It would have been a still greater pleasure to me to have been present at its deliberations, but at least I may do myself the honour of wishing you all every success in your joint endeavours in the cause of scientific truth and of the welfare of Mankind.'

Greetings have also been received from Professor Sir Joseph Barcroft (Cambridge), Professor Verney (Cambridge), Professor W. H. Howell (Baltimore), Professor C. H. Best (Toronto), Professor I. de Burgh Daly (Edinburgh), and Professor C. Lovatt Evans (London).

We are all most grateful to our distinguished colleagues abroad for their good wishes and co-operation which will undoubtedly go a long way to help us to take our task with redoubled zeal and effort.

The two greatest needs of the hour in the scientific world in India are:—

(*a*) To have more scientific workers of first-class ability.

(*b*) To have amongst the scientific workers harmony and goodwill.

Let me take you back for a moment again to William Harvey, about whom I have already spoken. In conveying his patrimonial estate of Burmarsh by means of an indenture to the Royal College of Physicians of London, he gives the following advice:—

> 'To search and study out the secrets of nature by way of experiment; and also for the honour of the profession to continue in mutual love and affection among themselves, ever remembering that *concordia res parvae crescunt discordia magnae dilabuntur.*'

I address these words not only to the Section of Physiology here but to all the scientific bodies in the country. Let us all follow Harvey's advice and live and work together like brothers in mutual harmony, peace, and goodwill in the interests of science.

Gatherings such as this, apart from promoting scientific discussions and advancement of science, bring about unity and friendship amongst the workers. They establish such contacts, as are not possible in any other way. This Section, I hope, will promote solidarity and cordial relations amongst all physiologists in India. Thus, Physiology will make a great headway, and its progress will be a source of pride to us all.

Let us therefore march forward and fulfil our mission of serving Physiology with faith, hope and charity, — with FAITH in the ultimate benign aim of our science; with HOPE, which will strengthen all our efforts; and with CHARITY,

in which as men of science to be worthy of our vocation, we must live, move, and have our being.

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VIII

SOME LANDMARKS IN THE GROWTH OF MEDICAL RESEARCH IN INDIA*

I am very happy to have this opportunity to say a few words on the subject of 'Some Landmarks in the growth of Medical Research in India'. This, I expect, is a subject in which all of us present here would be interested, no matter what medical speciality we belong to. This is a Joint Conference composed of Members of the Association of Physicians of India, the Cardiological Society of India, the Neurological Society of India, the Indian Society of Haematology, the Indian Association of Chest Diseases, as well as the Indian Society of Gastroenterology. It is a very representative body, and its interesting feature is, that the members bring with them a very keen spirit of scientific enquiry, love of scientific truth, and a great desire for more knowledge. This is highly commendable. In a gathering like this, I feel that it would not be out of place to recall for a brief space of time how this spirit has grown in this country. In all activities of the human mind, a historical survey is always desirable and helpful, for it gives us a comprehensive idea as to how it developed in the past, and guides us as to our future line of action. I would wish

* An address delivered at the Joint Conference of The Association of Physicians of India, The Cardiological Society of India, The Neurological Society of India, The Indian Society of Haematology, The Indian Association of Chest Diseases, as well as The Indian Society of Gastroenterology, at Madras on the 16th January 1961.

Reprinted from the *Journal of the Association of Physicians of India.*

that the Indian Association of the History of Medicine, at whose invitation this lecture was originally arranged, should also hold its annual session in future as part of this Joint Conference. I hope this can be arranged.

In considering the history of medical research in India, I shall not start at the very beginning. Medicine as you know, has been practised and taught in India since very ancient days and great contributions were made to it, of which we may be proud. The system which is indigenous to the soil is the Ayurveda. Medical Research however, as we know it today, is really a part of the scientific revolution, which dates from the Renaissance, which took place in Europe from the 15th and 16th centuries onwards.

What happened during the Renaissance, which gave such an impetus to the growth, not only of medicine but of science generally, resulting in the Scientific Age, in which we live today? The Renaissance consisted of a revival of learning. It commenced in Italy and spread over the Continent. It was a new spirit, a new desire for knowledge and progress which affected every sphere of life. Unquestioning acceptance of authority, specially authority of the written word, gave way to criticism and enquiry, and medicine, which had scarcely advanced since the days of Hippocrates and Galen, was quickly enriched with new discoveries. This change took place gradually. It is important to realise, that mankind is slower to change its attitude of mind than many of us realise.

There is a definite contrast between mediaeval and modern times. An atmosphere hostile to free enquiry gave way to one in which science could live and flourish. During the Middle Ages the Church was the sole repository of culture. But in the 15th and 16th centuries there began

an enquiry of nature, which led to the development of modern medicine and science generally, and through the invention of printing, which took place about that time, the new culture which had started, became a general possession of a much larger number of people, than was the case before. 'With a sharp gesture of impatience' says H. A. L. Fisher (the Oxford historian), 'Europe turned away from the vast literature of commentaries and glossaries, which the pedants of the later Middle Ages had inscribed in letters of opium on tablets of lead.' This was the free atmosphere, illuminated by a new spirit of adventure and enquiry, and which cherished views of life based on freedom of thought, and right of the individual conscience, which came to India by our contact with the West.

The man who revolutionised Medicine in Europe, at this time was Andreas Vesalius, born in Brussels in 1514, who became Professor at Padua University at the age of 29, and who had the courage to criticise and differ from the views of Galen, whose classical medical teachings were then widely current throughout the Continent. He wrote a book '*De Humani Corporis Fabrica*' based on dissections of the human body, carried out by himself under great difficulties, and which according to Sir William Osler, is 'the greatest book ever printed from which modern medicine dates.'

There are many illustrious names of physicians and other scientists who had caught the spirit of the Renaissance, and made many contributions to Scientific Medicine, namely William Harvey, Thomas Leinacre, Laennec, Edward Jenner, Louis Pasteur, Joseph Lister, Robert Koch and others. Medicine made great progress in the 18th and 19th centuries, but the rapidity with which it is advancing in the 20th century is beyond the imagination of any of the previous generations.

Medical Research in India: Early Stages:

India too, as I said, came under the influence of this Renaissance at a time when the systems of medicine in vogue here were the Ayurvedic and Unani. But the progress in the earlier stages was slow as was the case in Europe also. As you know, we had the Portuguese, the Dutch, the British, the French and the Danes here, but so far as Medicine is concerned we are mainly concerned with the British, who came at the beginning of the 17th century. The first medical officers in the employ of the East India Company were Surgeons on board the ships. Subsequently, they organised Medical Services for the Army and the civil population.

So far as medical research in this country is concerned, we may divide it into two phases:—

(a) The phase when research was carried out by individuals at their own initiative. This period extends upto the close of the 19th century.

(b) The phase, when organisation of medical research took place on an institutional basis. This phase begins with the commencement of the 20th century.

I shall briefly consider the activities of the first phase.

Prior to the organisation of Medical Research at the beginning of this century, the following names of pioneers in this field may be mentioned:—

1. Lewis's work on Trypanosomes.
2. Vandyke Carter's work on spirillum of Relapsing Fever, Leprosy, and Mycetoma infections. He did this work in Grant Medical College, Bombay.
3. Macnamara and Cunningham's work on Cholera.
4. Ronald Ross's great discovery of the transmission

of Malaria by the Anopheles Mosquitoes in 1898. This work was done by Ross in a hospital in Begampet, Hyderabad (Dn). This building is still there, and I am well acquainted with it.

5. James Esdaile is well known for his work on Mesmerism. He demonstrated the possibility of performing major surgical operations painlessly under anaesthesia caused by Mesmerism. He started this work in 1845 in a hospital in Calcutta and continued it till 1851 when he left India. It was during this period (1846–1847) that Sir James Simpson in England also worked on Ether and Chloroform as anaesthetics. In Bombay Dr. W. Nunan who was Police Surgeon there some years ago, followed Esdaile's methods and used hypnotism as a means of cure of many ailments.

6. Haffkine's work on Plague in Bombay. Plague appeared in Bombay in 1896. It rapidly spread over wide areas in India. Haffkine who at the time was studying prophylactic inoculation against Cholera in Bengal, was sent to Bombay to study Plague. He carried out his investigations in a room at the top floor of the F. D. Petit Laboratory in the compound of Grant Medical College, Bombay and was successful in manufacturing plague vaccine as a prophylactic. The space in that laboratory was limited, and provision had to be made for accommodation on a larger scale. For this purpose the old Government House at Parel was taken over in 1900, and converted into Bombay Bacteriological laboratory, subsequently known as the Haffkine Institute.

Among the Early Indian Workers, I may mention the names of Dr. K. N. Brahmachari, Sir Nilratan Sircar, Sir Nusserwanji Choksey, Dr. R. Rao, Dr. Surveyor, Sri R. N. Chopra and others.

ORGANISATION OF MEDICAL RESEARCH IN INDIA

(A) ESTABLISHMENT OF RESEARCH INSTITUTES AND LABORATORIES

1. *The Haffkine Institute:*

The need for Organised Medical Research in India was acutely felt at the close of the last century, when there was an epidemic of Plague in the country, and it was Haffkine's work in Bombay which set the ball rolling. The conversion of the old Government House in Parel into a Research Laboratory in 1900 was the first step in this direction. The functions of the Haffkine Institute were to undertake research work and to do routine public health laboratory work and to manufacture sera, vaccines and other biological products.

It manufactured plague, cholera, TAB and anti-rabic vaccines, anti-toxins and toxoids, including tetanus, diphtheria and gas gangrene toxoids, anti-dysentery and anti-plague sera. It undertook work connected with clinical pathology, analysis of food and water for the Public Health Department, tests for nutritional value of food stuffs and gave advice to government on public health matters. It also maintained a Blood Bank.

The Haffkine Institute has a very fine record of research work, consisting of treatment of plague, Leptospirosis, Typhus, nutritional factors in hepatic cirrhosis and pharmacological problems. Its field of activities has become wider and wider.

It is also a training centre for Medical and Public Health Officers and Sanitary Inspectors.

Apart from the establishment of this Institute, the Secretary of State for India had appointed a Committee to look into the problems of rat-flea as the vector of plague. On this Committee, there were representatives of the Royal Society and of the Lister Institute of Preventive Medicine, London.

2. *The King Institute of Preventive Medicine, Madras:*

In 1903-1904 another Institute known as the King Institute of Preventive Medicine was started at Guindy, Madras, with the object of doing research on bacteriological and other problems, routine bacteriological work, as well as the manufacture of calf lymph. Research at this Institute consists of work on viruses, typhus, Dengue, Trachoma, Cholera, Plague, Malaria, endemic Fluorosis, water and sewage, bacteriology and investigations on the algal flora in water supplies.

I may point out here, that it was the pioneer work of Patern and Koch, as well as that of Edward Jenner, which was the main source of inspiration in India, so that the laboratories which were established here, had for their function the task of doing research work, mostly bacteriological in nature, as well as routine bacteriological work for diagnostic purposes, and manufacture of vaccines, especially vaccine lymph, which was greatly in demand on account of the prevalence of small-pox in the country.

After the establishment of the Haffkine Institute in Bombay in 1900 and the King Institute of Preventive Medicine at Guindy, Madras in 1903-1904 the following Institutes came into being in the country.

3. *The Central Research Institute at Kasauli in 1906:*

This served as a Provincial Laboratory for Punjab also. Here Christophers carried out his classical studies on Malaria and Cragg did his investigations on Typhus and Relapsing Fever.

4. *Pasteur Institute of Southern India at Coonoor in 1907:*

The major portion of the funds for this Institute were supplied by an American philanthropist, Mr. Henry Phipps. It is the property of Pasteur Institute Association, a body registered under the Societies Registration Act of 1860. The management is in the hands of a Central Committee, of which the Director of Medical Services, Madras, is the Chairman, and the Director of the Institute is the Secretary.

5. *The Pasteur and Medical Research Institute at Shillong, Assam, in 1917:*

It was originally opened as an anti-rabic Centre by government. The Assam Branch of the Tea Association gave a donation towards it. Some good research work has been done here.

A special feature of this institute was, that it had a clinical research hospital attached to it, which is extremely useful for clinical investigations. Research work has been done here on the treatment of Kala Azar by antimony compounds and the treatment of Cholera and Dysentery by bacteriophages. Work has also been done on Malaria, and Naga sores.

6. *The School of Tropical Medicine, Calcutta, in 1922:*

This was founded through the initiative of Sir Leonard Rogers. The Research work here covers tropical Medicine,

Pharmacology, Entomology, Chemistry, Pathology, Bacteriology, Protozoology, Haematology, Diabetes, Filariasis, Helminthology, Leprosy, indigenous medicine, etc. It is primarily a teaching centre, where instruction is given for the Diploma in Tropical Medicine of the Faculty of Medicine and Hygiene, Bengal.

7. *All-India Institute of Hygiene and Public Health, Calcutta, 1932:*

It was opened for the purpose of investigating methods of applying knowledge for medical protection to large groups of the community and of training students in these methods. There are six teaching sections, namely:—

(a) Public Health Administration.
(b) Vital Statistics and Epidemiology.
(c) Microbiology, including Bacteriology, Immunology and Serology, filterable virus and the Rickettsias, Medical Entomology, Protozoology and Helminthology.
(d) Biochemistry, Nutrition, and Physiological Hygiene (including Public Health Chemistry and Physiology applied to Public Health).
(e) Sanitary Engineering.
(f) Maternity and Child Welfare.

Regular postgraduate courses are held for the DPH and Nursing and DMCW diplomas. Facilities are also available to prepare for the D.Sc. degree in Public Health of Calcutta University. The Institute collaborates with the School of Tropical Medicine in its regular courses. The Calcutta Blood Bank is housed here, as well as the Biochemical standardisation Laboratory. The Health Centre at Singur which is attached to this Institute, offers facilities for teaching and research. This Centre is a controlled experi-

mental area for applying knowledge to large community groups.

The Institute has done good research work on epidemic dropsy. Malaria, Tuberculosis, Kala Azar, Nutrition, Biochemistry and the clinical aspects of Maternity and Child Welfare.

8. *The Malaria Institute of India, Delhi in 1940:*

The Malaria Survey of India was constituted in 1926, and it took over the functions of the Central Malaria Bureau, which was then located in the Central Research Institute at Kasuali. In addition to this, there was a large experimental station in a hyperendemic area in Karnal (in the Punjab) for the purpose of conducting field researches.

In 1936, this organisation was entrusted with the responsibility of anti-malaria work in Delhi. In 1940 the Government of India placed suitable buildings in Delhi at its disposal and the name Malaria Institute of India was given to it. Subsequently, the experimental station at Karnal was given up.

The Institute has a splendid record of work behind it. It is both a teaching and a research centre. Apart from Malaria, it has assisted researches in Kala Azar, Filariasis, Sandfly fever, Dengue and Stegomyia.

In 1942, the Rockfeller Foundation donated the equipment of Dr. Paul Russell's Research Unit at Coonoor to form a branch of the Malaria Institute in South India.

9. *Nutrition Research Laboratories:*

These laboratories were formerly housed in the Pasteur Institute, Coonoor. They have been shifted to a new building, which is located in the Campus of the Osmania Uni-

versity at Hyderabad (Dn). I had a hand in getting this site for the new buildings, which are ready now and have been partly occupied. The new laboratories stand in an area, where academic atmosphere prevails. There are the Physiology and Biochemistry departments of the Medical College as well as the Veterinary Institute, the Animal Husbandry Institute of the Agricultural College, with its farms, and the newly built Central Laboratories of the Council of Scientific and Industrial Research of Hyderabad. Here we may hope, that the science of Nutrition will advance rapidly in the widest possible manner.

The Nutrition Laboratories owe their inception to Sir Robert MacCarrison, who worked there at first on the effects of faulty diet on Thyroid gland. He subsequently extended his researches to cover the pathological changes caused by defective diet in most organs of the body. His earlier work was on Beri-Beri, which was later designated as 'Deficiency Diseases Enquiry.'

These laboratories were established on a semi-permanent basis in 1925. Since then their activities have extended. Dietary Surveys have been carried out in many parts of the country. Work has been done on nutritive value of food stuffs, methods of vitamin testing, basic nutritional research, animal experimentation, and clinical investigations.

10. *The Indian Institute of Medical Research, Calcutta:*

This was founded by private enterprise through the initiative of Dr. J. C. Ray. It has recently been taken over by the Council of Scientific and Industrial Research. Its name has been changed to the *Indian Institute for Biochemistry and Experimental Medicine.* It deals with problems of biochemical, immunological, pharmacological,

physiological and biochemical nature, and has an excellent record of work done.

11. *The Tata Memorial Hospital, Bombay:*

This was established in 1941. It is specially equipped for research in Biochemistry, Biophysics, Pathology, and clinical subjects, especially surgery and radiotherapy of Cancer.

There is also *Cancer Research Centre* attached to it, where Dr. V. R. Khanolkar and his colleagues are doing excellent work.

12. *The Indian Institute of Science, Bangalore:*

This well-known Institute has expanded its activities. The departments of Biochemistry and Pharmacology here are engaged in research work, on various drugs, some belonging to the indigenous systems of medicine. Work on vitamins, Insulin, Pituitrin, Adrenalin and Penicillin has been done here, as well as studies in sewage purification, sewage farming, treatment of brackish water and the hygienic treatment of industrial liquid wastes.

13. *Imperial Agricultural Research Institute, New Delhi:*

This was established in New Delhi, in 1935, after the Institute at Pusa (Bihar) was badly damaged. The investigations here cover fields which are sufficiently allied to medical subjects. It is desirable to have a closer liaison between Medical and Agricultural Research than has been the case before.

14. *Virus Research Centre, Poona:*

In 1950 with the aid of the Rockefeller Foundation a Virus Research Centre was established in Poona for studying problems connected with arthropod borne virus diseases.

15. There are some other laboratories, such as the Central Drug Research Institute, Lucknow; the National Chemical Laboratory; the National Physical Laboratory etc. Certain investigations carried out there have also a definite bearing on medical research.

This is a brief account of some of the Institutes, which have been established in India for the purpose of undertaking medical research. The list is by no means complete but it does give an idea, that definite progress has been made in this sphere. Since Independence in 1947 the output of research work has increased considerably.

(B) MEDICAL EDUCATION AND MEDICAL RESEARCH

Medical Education is closely linked with medical research. The two are really inseparable. This is specially true of Post-graduate Medical Education. In a Medical College, training of postgraduate stimulates the prosecution of research.

Research in fact is a necessary condition laid down by most Universities imparting training for higher examinations, namely for M.D. and M.S. Degrees. Condidates before appearing for these examinations have to write a thesis based on research work done by them under the guidance of a recognised teacher.

During the last ten years many Universities have become alive to the necessity of developing postgraduate education and research in their Colleges, and in this movement the Government of India and the State Governments are helping actively.

The following facilities have been provided in this field:—

(1) *All-India Institute of Medical Sciences, New Delhi:* The Bhore Committee recommended the establishment of

a Medical Institute for postgraduate training and research in Medical Studies. This was to be an Institute of an All-India character.

An All-India Medical Institute Committee was constituted by the Government of India in 1946 to put forward detailed recommendations for the establishment of such an Institute. The Ministry of Health in consultation with the University of Delhi reserved 400 acres of land in the neighbourhood of the University Campus, as it was rightly thought that the new Institute should form an integral part of Delhi University academically, but at the same time should retain its independence from the administrative point of view. For financial reasons, this idea was dropped.

It was then decided by Government to have the Institute in the Irwin Hospital premises. This scheme was accepted in 1951-52. At that time, there came a generous offer of one million pounds from the New Zealand Government under the Colombo Plan to assist the Government of India to establish the Institute. This facilitated the arrangements for establishing the Institute, the scheme for which was readily accepted by the New Zealand Government as well as the Indian Government. The foundation stone for it was laid in the Irwin Hospital premises by the Hon'ble Minister the Hon'ble Mr. J. D. Watts, Minister for Industry and Commerce, Government of New Zealand, on 4th April 1952. But administrative difficulties arose and the scheme was dropped. It was shifted from the Irwin Hospital to its present site opposite the Safdarjang Hospital.

The present scheme under which the Institute is being established is estimated to cost Rs. 10 crores, and includes the provision for the establishment of a Medical College

for undergraduate instruction as well as for postgraduate instruction and research.

2. *Vallabhbhai Patel Chest Institute, Delhi:*

This Institute was formally opened in 1955. It gives postgraduate courses in chest diseases under the Medical Faculty of Delhi University. The Institute is affiliated to the Delhi University, and is situated on the University Campus.

During the short period of its existence it has already done a good deal of Research work. It has 5 sections for purposes of research:—

(a) Bacteriology.

(b) Pathology.

(c) Biochemistry.

(d) Cardio-respiratory Physiology.

(e) Clinical Research.

3. *Upgrading of certain Departments in Medical Colleges:*

The following departments in various teaching institutions have been upgraded for research.

1. Institute of Obstetrics and Gynaecology at the Government Hospital for Women and Children, Madras.
2. Institute of Venereology, Government General Hospital, Madras.
3. Institute of Anatomy, Stanley Medical College, Madras.
4. Department of Pediatrics, Madras Medical College, Madras.

5. Barnard Institute of Radiology, Government General Hospital, Madras.
6. Physiology Department, Medical College, Patna, Bihar.
7. Department of Pathology, Andhra Medical College, Vizagapatnam.
8. Department of Plastic and Maxillo-Facial Surgery, Medical College, Nagpur.
9. All-India Institute of Mental Health, Bangalore.
10. Indian Cancer Research Centre, Bombay.
11. Vallabhbhai Patel Chest Institute, Delhi.
12. Thoracic Surgery Unit, Christian Medical College, Vellore.
13. Virus Research Centre, Poona.
14. The Department of History of Medicine, Osmania Medical College, Hyderabad (Dn).

(C) ESTABLISHMENT OF THE INDIAN RESEARCH FUND ASSOCIATION AND THE INDIAN COUNCIL OF MEDICAL RESEARCH

In 1911, the Indian Research Fund Association was founded. This was an important step in the progress of Medical Research in India. The work of the Association was taken over by the Indian Council of Medical Research in 1949. Like the I.R.F.A. it has a Governing Body and a Scientific Advisory Board and a number of Advisory Committees and Sub-Committees have been appointed to deal with various branches of Medicine. They give advice on scientific matters and go through various schemes for research, which are submitted to the Indian Council of Medical Research. The Council approves an annual pro-

gramme of research, sanctions grants in aid for research purposes, and in certain cases constitutes special enquiries.

The Indian Council of Medical Research has taken special interest in recent years in promoting research in Medical Colleges. The meetings of the Scientific Advisory Board and the Advisory Committees are now held in Medical Colleges, and they serve the important function of stimulating research work in these teaching institutions. It is a happy sign of the times, that most medical colleges are undertaking research work now, so that our aim of imparting Medical education in an atmosphere of research is being fulfilled.

I have had the privilege of serving as a member of the Governing Body of the Indian Research Fund Association and subsequently as a member of the Scientific Advisory Board of the Indian Council of Medical Research for a number of years, and am well acquainted with the great contribution that the Council has made to the advancement of Medical Research in India. A number of States have appointed Research Committees for the promotion of Research and have granted some funds to the Medical Colleges in their areas for research purposes. More financial help from the States for this purpose is necessary. The Rockefeller Foundation has extended a programme of Fellowships for the training of necessary research personnel. A number of research units have been organised in the Medical Colleges, such as Polio-Research Unit at Grant Medical College, Bombay, a Neurophysiological Unit at the All-India Institute of Medical Sciences, New Delhi, a Nutrition Research Unit at Seth G. S. Medical College at Bombay and Liver Diseases Research Unit at the Medical College, Agra.

There has been a great increase in the number of Medical Colleges. There are about 58 Medical Colleges in the country now. The number of research workers in them has considerably increased. I understand, that nearly 30% of the Council's Funds available for research programmes are now spent in the Medical Colleges against 5% in 1939.

It is gratifying that younger members of the teaching staff of colleges are becoming more actively interested in research and we may look forward to greater output of research from these institutions in future.

Co-operation with other National and International Agencies.

The Indian Council of Medical Research is in laison with the Council of Scientific and Industrial Research and the Indian Council of Agricultural Research. In recent years, it is also closely connected with the Armed Forces Medical Services, which was not the case before. There are numerous problems common to them both, and mutual discussions and consultations are beneficial to each.

It has also been co-operating with the State and Central Services in the control of certain diseases, such as Malaria and Filariasis and endemic Goitre. This co-operation is going to be still closer in future, particularly in regard to the problems of Nutrition, Maternity and Child Health, Environmental Hygiene and Communicable Diseases. The Community Project areas and National Extension Service Blocks also provide excellent facilities for useful collaborative studies.

In the International field also the Council has been in close co-operation with a number of Agencies. The Rockefeller Foundation has started a training programme by means of Fellowships. The Foundation was very helpful

in establishing the Virus Research Centre at Poona, especially for the study of problems of insect-transmitted virus diseases. The W.H.O. has made a handsome contribution to the Cholera Research programme of the Council. It has also donated essential equipment for the Poliomyelitis Research Centre and is extending substantial help in the solution of the problem of Protein Malnutrition. W.H.O. co-operation is available also in the control of Tuberculosis and Trachoma, and some aspects of heart diseases. The Technical Co-operation Mission has donated special equipment to the Nutrition Research Laboratories, Coonoor.

The International Agencies (Technical Co-operation Mission, the Colombo Plan, the Rockefeller Foundation and the W.H.O.) also provide scholarships to the research workers for higher training abroad and to teachers in Medical Colleges to raise the standard of medical education.

Role of the Medical Council of India in promoting research:

The Medical Council of India has been functioning since 1934. Till 1950 it concerned itself mainly with the undergraduate education. But in recent years it has taken more active interest in post-graduate medical education and research, these subjects being closely related to each other. On 5th April 1958, the Council passed the following resolution:—

> "Resolved that information be obtained from each Medical College and each University in India regarding the research programmes carried out by the Head and other Assistants of each department of the College and other post-graduate departments and institutions. Each medical College and each University be requested to go into the question of supervision of

research work carried out in its department and furnish information annually to the Council."

On a previous occasion, on 27th September 1957, the Council resolved to recommend, that the Universities should set up Boards of Post-graduate Medical Education and Research within the Universities to stimulate and organise research.

I am sure, these measures would undoubtedly have a very beneficial effect on further progress of research in the Universities and Medical Colleges.

MEDICAL RESEARCH IN INDIA TODAY

Modern Trends:

1. The need for developing properly staffed and well equipped research Units in Medical Colleges and teaching hospitals has been strongly felt and although good progress has been made in recent years, this line of work should be further pursued with increasing vigour. Various research Institutions should be brought into closer touch with the Universities.

2. The subjects of Biochemistry, Biophysics, Endocrinology, Genetics, Physiology, Parasitology and Mycology, are of fundamental importance, and need to be further encouraged.

3. In view of the wide-spread malnutrition in the country it is necessary to impart education in Nutrition as part of Health as well as general education in the country; to protect the vulnerable groups of the population, namely infants and growing children, to control specific diseases of nutrition, namely Endemic Goitre, Lathyrism and Fluorosis, which are

prevalent in localised areas in the country and to organise Nutrition work as an integral part of the State Health Department. It is imperative to have a comprehensive Food and Nutrition policy for the country.

4. In undertaking programme of research in communicable diseases, the new knowledge gained should be applied for their prevention and eradication as expeditiously as possible. This is being done in the case of malaria with encouraging results, and the same policy should be adopted for other communicable diseases, such as Tuberculosis, Virus Diseases etc.

5. In the field of Maternal and Child Health, there is need for great increase in research as well as application of knowledge already available. Although there is definite diminution in the maternal and infantile mortality rates in the country on account of vigorous work of the Maternity and Child Welfare Organisations in recent years, the rates are still higher as compared with some of the Western countries. We know, that the important causes of maternal mortality are infections, anaemias and toxaemias of pregnancy, and as regards infantile mortality, the main causes are prematurity, gastro-intestinal and respiratory diseases. There is need to apply the existing knowledge fully for the protection of mothers and children against these ailments as well as for the promotion of positive health as expeditiously as possible. The services to mothers and children, I am glad, have already been an integral

part of the Public Health Service in all the States. This link should be further strengthened.

The infants and children are the future citizens of India, and we should give the highest priority to their welfare in our programme of research.

6. *Fundamental Research:*

Fundamental research in Medicine and allied subjects also gets support from the Indian Council of Medical Research, but it is in this field, that the Universities should come in and offer their helping hand for it is their special province. It is hardly necessary to emphasise the importance of Fundamental Research as it is on this, in the last resort, that all applied research is based. There should be a liaison between the Medical Colleges, and the departments of Chemistry, Physics and Biology of the Universities. It is in the application of the knowledge of Chemistry and Physics to biological investigations that advancement of Medicine has taken place. I trust that the Institute of Biology envisaged by the C.S.I.R. will soon be established.

7. The study of problems connected with preventive and social medicine demands greater attention. I have already referred to the control of communicable diseases. Apart from this, it is necessary to devote more attention to environmental sanitation. As you know, during the latter part of the First Five Year Plan, the Central and State Governments have launched a campaign for the eradication of Malaria with encouraging results.

A National Water Supply and Sanitation programme, which involves an expenditure of about Rs. 25 crores, is contemplated, for the control of water and filth borne diseases, such as Cholera, Typhoid and Dysenteries. It is of

course established, that safe water supplies and sanitary methods of excreta disposal are essential for this purpose. These essential amenities however are not available in all parts of this country.

The success of this programme depends on the application of known scientific methods in public health work. There are various factors concerned, namely customs and habits of the people, climatic variations, economic conditions etc. These problems are awaiting solution.

8. *Industrial Medicine:* On account of the rapid growth of industrialisation, the health of the industrial worker needs to be specially looked after.

9. *Mental Health and Disease:*

The study of mental health and disease, which is now being undertaken, also needs to be pursued with increasing vigour, and facilities for this should be further extended.

10. *Social Medicine:*

The scope of Medicine is enlarging. A new discipline, known as Social Medicine, is emerging and needs immediate attention. We must study disease in relation to social as well as physical environment, and this includes study of its social, cultural economic and historical aspects.

CONCLUDING REMARKS

This briefly is the story of men and organisations, which have helped the growth of Modern Medicine and led to the present stage of Medical Research in India. We have a creditable record in this sphere already. Good work has been done in Plague, Leprosy, Malaria, Cholera, Virus diseases, Tuberculosis, Trachoma and indigenous drugs. As

the result of the knowledge gained, there is definite reduction in the incidence of some of these diseases. Plague on which Haffkine first started working in Bombay has been fully controlled, and the endemic areas are free from this infection. Malaria is being controlled and now a programme for the eradication of this disease is well in hand. Filariasis is being prevented, Tuberculosis is also being handled successfully. Good work has been done on Leprosy, especially at the Cancer Research Centre, Bombay, which will help us materially to control the disease. Studies on Nutrition have given us valuable information as to the main causes of malnutrition, and deficiency diseases in the country. Drug Research has given us some valuable remedies for certain ailments, and has strengthened the armamentarium of the physician to deal with certain diseases.

Apart from this, considerable amount of research work of the clinical type is being done in various medical specialities, as is evident from the work of various Associations. This is all to the good, and we are very happy about it. But there is no cause for complacency. "There is no limit at all to the Science of life," says Charaka, while addressing the students in the Samavartana ceremony at the conclusion of studies and advises them to apply themselves to it with diligence. The problems requiring solution are so numerous, and the number of workers still far from sufficient. All this work must continue with unmitigated zeal. Our immediate aim should be to provide more trained workers and to increase the facilities for research work in the Medical Colleges, the Universities and the research institutes.

In the evolution of Medicine, we can trace a number of stages: an early stage, in which it emerged from magic

and religion into an empirical art; a stage in which the importance of its study as a phenomenon of nature was recognised; a stage in which Anatomy and Physiology of the human being drew attention; a stage in which the causes of ailments were studied; and finally a stage as we witness today, when knowledge gained, is used not only for the cure but also for the prevention of disease. This is a revolutionary change and has completely altered our attitude towards disease. It was Discartes, who truly said, that we could be freed from an infinity of maladies both of body and mind, if we had sufficient knowledge of their causes, as well as knowledge of all the remedies which have been provided by nature. It is this knowledge, that we are steadily gathering in modern times, which is helping us to control certain diseases, especially in countries like India, where owing to various causes, so many communicable diseases are still so rampant, causing such a high rate of mortality and morbidity.

Medical Research is essentially a humanitarian task, for its fundamental aim is to relieve suffering and pain. From times immemorial Medicine has been a synthesis of Science and the Humanities. Likewise all sciences should be used for the welfare of man and not for his destruction. It is necessary to emphasise this in this atomic age, when there is danger of nuclear warfare.

In this fight against disease there are three important weapons in our armamentarium, namely, Education, Organisation and Co-operation. Education and training of the scientific worker, organisation of research facilities, and co-operation between different disciplines to work together in their search for scientific truth. If we continue to work in this spirit, we can rid our country completely

of disease and suffering, we can raise the standard of positive health of our people, which will result in greater happiness and prosperity and see before long the dawn of that great day of which Shelley sings so nobly:—

"Happiness and Science dawn, though late, upon
the Earth;
Peace cheers the mind, health renovates the frame;
Disease and pleasure cease to mingle here,
Reason and passion cease to combat there,
Whilst mind unfettered o'er the Earth extends
Its all subduing energies, and wields,
The spectre of a vast dominion there."

IX

HISTORY OF CERTAIN ASPECTS OE NEUROLOGY*

History is simply the biography of the mind of man. To understand clearly our position in any science today we must go back to the beginnings, and trace its gradual development, following certain laws which illustrate this biography, this human endeavour working through the long ages. It is in this way, that we can trace the growth of Truth, especially the Truth, which we call Science. This subject has three facets:

In the first place, scientific Truth grows like a living organism. Its gradual evolution can be traced from the tiny germ to the mature product. Truth may suffer all the hazards incident to generation and gestation. We may find that Truth was born after a great deal of struggle only to die, or else to wither away in premature decay. Or, it may be dormant for centuries, awaiting the fullness of time, when it blossoms out again.

Secondly, all scientific Truth is conditioned by the state of knowledge, which exists at the time of its announcement.

Thirdly, scientific Truth compels general acquiescence. This acquiescence is often of slow growth, but ultimately its acceptance is obtained more widely than that of any other product of human mind. This acquiescence has no limitations of any kind, whether geographical, racial or religious. It is universal.

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* Lecture deliverad at the XVI Annual Conference of the Neurological Society of India, held at Bangalore, December 1966.
Reprinted from *Neurology India*, April-June 1967.

As *Sir Michael Foster* says, "What we know and what we think is not a new fountain, gushing fresh from the barren rock of the unknown at the stroke of the rod of our own intellect; it is a stream which flows by us and through us, fed by the far off rivulets of long ago.... Tracking out how new thoughts are linked to old ones, seeing how an error cast into the stream of knowledge leaves a streak lasting through many changes of the ways of man, noting the struggle through which a truth now rising to the surface, now seemingly lost in the depths, eventually swims triumphant in the flood, we may perhaps the better learn to appraise our present knowledge, and the more rightly judge, which of the thoughts of today is in the direct line of progress, carrying the truth of yesterday on to that of tomorrow, and which is a mere fragment of the hour, floating conspicuous on the surface now, but destined soon to sink, and later to be wholly forgot."

When the 16th century was drawing to a close it was a period of acquisition unequalled in history. The Medieval period was coming to an end, and the spirit of the Renaissance was bringing out a new science, which basically altered the intellectual atmosphere in Europe, promising a new heaven and a new earth. To medicine it gave a new spirit. In the latter part of the 15th century the Greek physicians, *Hippocrates* and *Galen*, came into their own again. There was a wave of enthusiasm amongst the leaders of the medical profession to study their original writings and to imbibe their spirit to undertake independent research. The practical acquisition of the century was a new anatomy, which was due to the work of *Andreas Vesalius* (1514–1564) and his followers. Apart from correcting the work of *Galen*, it contributed to weaken the divine authority, with which *Galen* had dominated the medical schools

for centuries. It was under such circumstances, that *William Harvey* appeared on the scene. His work on the circulation of blood was a great source of inspiration to many workers. He was really the founder of the new physiology, as *Vesalius* was the founder of the new anatomy.

The history of neurology has been a great conflict between the dogmatic tradition and experimental observation. This was more so in this field than in any other branch of medicine. This conflict began to subside only during the last century with the advancement of modern scientific research. In neurology, as well as in psychiatry, progress was hampered by the traditional belief, that the brain and nervous system generally work at a higher level and regulate man's relationship with God and Nature. This is the reason, as *Prof. Felise Marti Ibanez* says, why there is historical clash between the two principal attitudes governing neurological thought—the metaphysico-religious and the empirico-scientific.

The history of neurology did not begin with the simple anatomical description or of physiology of brain or description of nervous ailments. The whole history of neurology is too vast a subject to be treated in one lecture alone. I have, therefore, chosen some aspects of it, namely (1) Neurology in ancient system of medicine in India (Ayurveda), (2) Evolution of Neurology since the Renaissance and (3) History of the study of Reflex action.

NEUROLOGY IN AYURVEDA

Ayurveda or the Science of Life has been promulgated, according to *Charak*, for the well-being of the *Purusha* or the human being; and the way in which it has been

done has been described in a single sentence by *Susruta* as follows:

"Dosha, Dhatu, Mala Ammoolan he Sareeram" (SS 15-3), which means that the basic constituents of the body are *Dosha, Dhatu* and *Mala,* with which Ayurveda mainly deals.

As regards the *Purusha* or the human being, *Charak* says: "Mind, soul and body, this Trinity called person, rested on union, like three posts standing with one another's support. Upon that Trinity everything rests. That is called *Purusha* or Being. It is also animate. That is the subject matter of this science, Ayurveda."

The soul (*Aatma*), mind and body are inseparable. In Ayurvedic Physiology, the consideration of *Aatma* and of the mind is as important as consideration of the body.

Ayurvedic physiology is the science of *Dosha, Dhatu* and *Mala* in the normal condition. The Doshas are the regulators of the functions of the body. There are three *Doshas: Vata, Pittha and Kapha.*

The Dhatus are divided into 7 categories: *rasa,* blood, muscle, adipose tissue, bones, marrow and semen.

The *Malas* are the waste materials of the body. The term *Sarira* is used to signify the body. The body is living owing to the presence of *Aatma* or the soul. *Aatma* is given the greatest importance in Ayurveda.

According to *Vagbhata*—Vitiation of the three *doshas* means disease, their normal equality means health. Nervous diseases are caused by vitiation of *Vata.*

Vata

According to *Charak, Vata* in normal condition has the following functions:—

1. It is the regulator and supporter of all the component parts of the body, taken both collectively and individually.
2. It exists in the fivefold form of *praana, udaana, samaana, vyaana* and *apaana.*
3. It is the urging cause of movements of diverse kinds.
4. It restrains the mind (from all undesirable objects) and concentrates it on objects that are desirable.
5. It causes all the (ten) senses of knowledge, and action to perform their functions.
6. It connects all the sense objects (after contact with the senses) to the mind.
7. It holds together all the elements of the body.
8. It assists the cohesion of the particles of the body.
9. It causes speech.
10. It is the prime cause of touch and sound.
11. It is the origin of joy and cheerfulness.
12. It excites the heat of fire.
13. It absorbs up all *doshas.*
14. It throws out all impurities.
15. It pierces through all the ducts of the body, gross and fine.
16. It gives form to the embryo in the womb.
17. It furnishes evidence of the existence of life.

The word *Dhamani,* is used for vessels and nerves. The *Dhamanis,* going upwards cause five sense functions, i.e., breathing in and breathing out, yawning, sneezing, laughing and speaking. Those going downwards conduct downwards the wind, urine and faeces, sperm and ovum,

and the four running circularly through the body with innumerable branches in the whole body cause perspiration.

The nervous diseases are caused mostly by the filling of the empty canals by *Vata* either in the whole body or in particular parts, when it is deranged by unsuitable or insufficient diet, over-exertion, loss of blood, anxiety, grief etc. The symptoms are contraction and stiffness of joints, the bones as broken down, goose-skin, phantasy, pain in the arms, in back and in the head, the shrinking up of limbs, sleeplessness, abortion or loss of menses in women, of sperm in man, convulsions and numbness of limbs etc.

SPECIAL VATAROGAS

Aksepak	—	convulsions
Apatantraka	—	apoplectic convulsions
Daruna apatanaka	—	Hysteric convulsion (?)
Dandapatanaka	—	The body is stiff like a stick
Dhanupstamba	—	The body is crooked like a bow (Tetanus)
Bahyayama	—	Curving outside, and incurable form.
Papsavadha	—	Hemiplegia (*vedic paksahata*)
Sarvangavaga	—	Paralysis of the whole body (Tetanus universalis)
Ardits	—	Facial Paralysis
Hanugraha	—	Lockjaw-Trismus
Manyastambha	—	Stiff neck
Jivastambha	—	Tongue-paralysis
Sirograha	—	Brain paralysis
Grdhrasi	—	Ischias (Sciatica)
Visvaci	—	Paralysis of the arms and hands
Krostukasirsa	—	Inflammation of the knee joints
Kalayakhanja	—	St. Vitus' dance (?)
Vepathu	—	Paralysis agitans

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Limping and complete paralysis, numbness, stammering and other sufferings are also mentioned amongst *Vata-vyadhis* (Diseases of *Vata*). Treatment consisted of anointing, perspiring and nourishing remedies, enemeta, purgatives. Firm bandages were also mentioned.

EVOLUTION OF NEUROLOGY SINCE THE RENAISSANCE

The ancient Egyptians as well as the Greeks before Hippocrates observed many neurological ailments, such as meningitis, migraine, palsies, tremors etc., but did not interpret them in their relations with the nervous system. It is true, that craniotomies were practised in the ancient days in Egypt such as trephining. But this was not so much an attempt to penetrate the cranial cavity, as to provide an exit to the demons inside, who are supposed to harm the individual.

Further, in ancient days there was some conflict in regard to theories concerning the seat of the soul in the body. The pre-Homerics believed, that the seat of the soul was in the brain. In Homeric times this shifted to the heart, and it was believed that heart was the seat of life and passions. This idea still persists today. The post-Homeric physicians considered the brain to be animated by the breath of life and that this was the seat of the soul. The idea is basic to the study of neurology and psychiatry.

In the study of the history of neurology, as mentioned by *Walter Riese*, one observes two factors which have been considered in different ways through the ages:

(1) Changes which have taken place in the anatomic concept of the nervous organs.

(2) The notion of movement as an expression of the nervous functions in space.

Keeping this in mind, we find that the brain or the nervous system has been studied in three different ways:

(1) As the operative principle, an instrument or organ expressive of the intrinsic function of the living being, *a morphological part of pure physical configuration in space.* Thus the ancients saw the brain, upto the time of the Roman Empire.

(2) *As a static spatial or architectural arrangement,* an allegorical representation, a mere piece of the whole anatomic figure, built upon the religious idea of the microcosm as a reflection of the macrocosm. This idea prevailed in the middle ages.

(3) As a process arising from a *morphogenetic evolution in time.*

In the 19th century which was biologically minded, brain was considered to be the seat of physiological evolution.

In the old Greek system of medicine of the days of *Hippocrates* (460–355 B.C.) and *Galen* (A.D. 129–200), there was the concept of spirits, which were responsible for various functions of the body, and whose derangement caused disease. This idea prevailed during the middle ages and largely influenced the intellectual background of *Andreas Vesalius* who in the 16th century was undoubtedly one of the harbingers of the new Renaissance.

Andreas Vesalius was born in 1514, and died in 1564. In 1543, he published his book *Fabrica Humani Corporis* or structure of the human body, which was largely based on his own dissections of the human body. At that time, it was believed, that the heart was the seat of 'vital spirit', the liver was the seat of 'natural spirit', and the brain was the seat of the *'animal spirit'*.

In his book *Fabrica Humani Corporis, Vesalius* expresses his views regarding the nervous system as follows:

"As therefore the power of the vital soul (that is the sum total of the vital spirit, or the vital spirit regarded as a whole) is situated in the substance of the heart, and the power of the natural spirit in the proper substance of the liver, and as the liver prepares the cruder blood together with the natural spirit, and as the heart the purer blood, which together with the vital spirit, rushes with speed throughout the body, and as these viscera by means of the canals allotted to them distribute their products to all parts of the body, so also does the brain in appropriate structures, and in organs properly subserving its work, manufacture the animal spirit, which is by far the brightest and most delicate and indeed is a quality rather than an actual thing. And while on the one hand it employs this spirit for the operations of the chief soul, on the other hand, it is continually distributing it to the instruments of the senses, and of movements by means of nerves, as it were by cords, the soul never being lacking in this spirit, which may be regarded as the chief author of activities of those instruments, any more certainly than the liver and heart ever leave wholly destitute at least in health, any of the parts on which they bestow their products, although they do not always supply them either in the same quantity or the same quality. Nerves therefore serve the same purpose to the brain, that the great artery does to the heart, and the vena cava to the liver, inasmuch as they convey to the instruments to which ought to be sent the spirit prepared by the brain and hence may be regarded as the busy attendants and messengers of the brain."

And then he frankly expresses his inability to explain certain functions of the brain.

He says: "But how the brain performs its functions in imagination, in reasoning, in thinking and in memory (or in whatever way, following the dogmas of this or that man, you prefer to classify or name the several actions of the chief soul), I can form no opinion whatever. Nor do I think that anything more will be found by anatomy or by methods of those theologians, who deny the brute animals all power of reasoning, and indeed all the faculties belonging to what we call the chief soul. For as regards the structure of the brain, the monkey, dog, horse, cat and all quadrupeds, which I have hitherto examined, and indeed all birds, and many kinds of fish, resemble man in almost every particular."

Vesalius took a physiological view of the origin of the chief soul. As *Sir M. Foster* says: "The chief soul is to him (Andreas Vesalius) the totality of the *animal spirit*, just as the vital soul is the totality of the vital spirits; it is engendered in the brain, by virtue of the powers of the proper material and form of the brain, just as the vital soul is engendered by the substance of the heart, or as we should say in modern language, psychical phenomena are the outcome of the activity of the nervous tissues."

We may now pass on to *Rene Descartes* (1596–1650). The experimental method which was established by the scientific work of *Galileo* (1564–1642) gave rise to the formulation of natural laws. *Descartes* announced his view, that the body is nothing but an automatically operating machine. His name is of great importance in the history of medicine not only on account of his personal contribution as a physiologist and pathologist, but also on ac-

count of the effect that the Cartesian philosophy had on the evolution of medicine. *Descartes* maintained, that the knowledge of our own thoughts is the only absolutely certain fact. *Cogito ergo sum* (I think, therefore I exist). His work established the idea of an Infinite and Perfect Being, and of the corporeal world outside of our own being. According to him the corporeal world, which occupies all space, is infinitely divisible. The smallest particles are in motion and produce by their movements natural phenomena, that we observe. These movements in *Descartes's* prophetic concept were not in a straight line, but in an undulating motion. According to him the body is nothing but a machine in which the animal spirits were located in the brain and the nervous system, where they functioned according to simple physical and mechanical laws and produced movements of the body in response to change in environment as well as worked on the rational soul, giving rise to modifications of thought. During his time a doctrine was steadily gaining ground, that the nerves were tubes along which the animal spirits flowed. Laying hold of this idea, he constructed an ideal nervous machine consisting of brain as the centre, and of nervous tubes radiating from this centre and carrying the animal spirits to all parts of the body. Lastly, he says, "when the rational soul resides in this machine, it has its principal seat in the brain, and may be compared to the fountaineer who has to take his place in the reservoir, whence all the various tubes of these machines proceed whenever he wishes to set them going, to stop or in any way to change them."

He regarded the pineal gland as the primary reservoir and the ventricles of the brain as the secondary reservoirs of the animal spirits, which flowed from the brain along the tubular nerves and carried out movements of the

body, the energy of these spirits being supplied by the innate heat of the heart. According to him, pineal gland is the seat of imagination and common sensation.

The chief contribution of *Descartes* was, that he succeeded in showing that it was possible to apply to the interpretation not only of the physical but also of the psychical phenomena of the animal body, the same method, which is making such astounding progress today, when applied to the phenomenon of the material world. If we read between the lines, which he wrote, and if we substitute in place of the subtle fluid of the animal spirits, the molecular changes which we call a nervous impulse, if we replace his system of tubes with their valvular arrangement by the present system of nerves and the synapses whose linked arrangement determines the passage and effect the nervous impulses, *Descartes'* exposition will not appear so wholly different from the one which we have today. *Descartes* was a philosopher not a physiologist. He took interest in problems of the living body only so far as they bore on the greater problem of the why and the wherefore of the Universe.

Let us now turn to another great man of a different calibre, *Dr. Willis*. He was born at Great Bedwyn in Wiltshire on 27th January 1621, and died on 11th November 1675. He was not a philosopher like Descartes, but he possessed a practical knowledge of the detail of structure and functions of the body, and especially of the brain, in health and disease. His name is well known to all medical men in the term "Circle of Willis," situated at the base of the brain. In his researches on the brain, he was much assisted by *Richard Lower*.

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After *Willis* many valuable additions continued to be made to the anatomy of the brain from time to time; but for a long time no one took up the physiological enquiry, which was so marked in the middle of the 17th century.

Let us now consider the work of *Glisson* and *Haller*. *Glisson* was born at Rampesham in Dorset in 1597 and came to Gonville and Caius College Cambridge in 1617, where he first studied classics and later took up medicine. In 1634, he took his M.D. Degree and in 1636 became the Regius Professor of Physic in Cambridge University. He died at the ripe old age of 80 in 1677. He was a good anatomist and a sound physician. His book *Tractus de nature substantiae energetica* was published in 1627. In it he attempted to show, that all phenomena of living things, be they animal or vegetable and of things not alive, are successive developments of the one fundamental energy of nature. This fundamental energy is the function of being irritated, which is possessed by all living tissues, and is designated as *irritability*. He used this term to describe the property possessed by muscle, by virtue of which it responds by movement to an external stimulus. In this he anticipated modern teaching by at least 100 years. It is to *Glisson*, that we owe the first introduction of the idea of irritability, which was later revived by *Haller* in the next century. It was firmly established in neurological physiology, and has played an important part in the development of both physiology and pathology. The idea of irritability has been extended to the production of response in any way, not only by movement or by change of form only, but by any kind of change, such as chemical change, change of growth and so on, by which

irritability may be manifested, and by various agents by which it may be called forth.

Another important observation made by *Glisson* was, that when a muscle contracts it does not increase in bulk. Prior to this, the idea prevailed that a muscle during contraction was inflated and was increased in bulk. This was supported by *Borelli* and others. Nowadays, we have the plethysmographic proof, that *Glisson* was right and that there is no increase in the bulk of the contracting muscle.

Glisson's hypotheses are the outcome of the deliberation of an able thinker to explain important physiological phenomenon. He maintained, that irritability was the prime cause not only of muscular movement, but also of life itself. It was materialistic and mechanistic conception, taking origin from psychology and metaphysics so far as irritability is concerned. According to him, the power of movement is the property of the living organs and it is closely linked with the property of irritability.

This conception of *Glisson's* was supported by *Haller*.

Albert von Haller (1708–77) of Berne was a leader in Physiology in the 18th century. He was one of the intellectual geniuses, connected with the onset and growth of Renaissance. He was a pupil of *Boerhaave* at Leiden. He made many contributions to physiology and medicine, but so far as neurology is concerned, he showed by a series of experiments, that irritability is the property of muscle fibres, and that sensibility is the property of the nervous system or of muscular tissue through which nerves are passing. Muscles have also the capacity of contracting independently of nervous action, but sensibility is exclusively of nervous origin. This observation of *Haller's* is the foundation of the myogenic theory of heart beat, which

over a century later, finally overcame the neurogenic theory of *Borelli.*

Haller adopted the conception, that the movements of the body are the manifestations of the inherent contractile power of the muscle, the *vis insita* (the inherent force), which may develop itself spontaneously, but which is usually brought about into play by the instrumentality of the nerves, by the *vis nervosa.* He says, that experiments show us that only nerves feel. Only those parts of the body, which possess nerves, feel and that they feel through their nerves. All the nerves are gathered together into the 'Medulla Cerebri' (into the central part of the brain), whence it may be inferred, that this central part of the brain feels, and that in it "are presented to the mind the impression which the nerves distributed at their extreme ends have carried to the brain." *Haller* then discusses the view, that nervous action depends upon a fluid. He says:

"All the ancients attributed to the nerves a most subtle and attenuated humour or rather fluid, for the word humour suggests something sluggish, to which they gave the name of spirits, and which though invisible just like air, exercises a great power. This doctrine of spirits held its place for many years. But later on, it began to totter. Then a sect, by no means weak (namely that of Stahl) took up the position that the soul acted directly hand to hand in all the actions of the body, and did not make use of instruments, by which it covered its commands to distant parts. People began to doubt very much about these spirits, and indeed now even the most distinguished men share these doubts."

Then, after some discussion, he says that as both sensation and movement have their source in the medulla of the brain, this medulla is the seat of the soul.

In the 19th century, much progress has been made in our knowledge of the nervous system. *Charles Bell* and *Majendie* showed us the fundamental distinction between sensory and motor fibres. The hidden work of the vasomotor nerves has been revealed to us. The progress of physics and especially of electric science has given us conceptions of how the passage of sensation and of will power proceeds inwards and outwards along the nerve fibres. The microscopic studies of healthy and diseased nervous structures carried out with experiments on living animals have gathered for us knowledge concerning different parts of the brain, which serve the different functions of the mind, knowledge which is clear, definite and founded on fact. This progress is largely due to the fact, that we have investigated the functions of the nervous system in an attempt to follow the inspiring example of *Haller*. In modern times, *Professor A. V. Hill* has elucidated the thermodynamics of muscular contraction. *William Einthoven* investigated the electric current of the heart by means of string galvanometer. *Lord Adrian* introduced electroencephalography. *Professor Langley* worked on the Autonomic Nervous System. Such basic investigations have proved of utmost value in throwing light on most problems on the clinical side of neurology.

HISTORY OF REFLEX ACTION

When we conceive of the nervous system as instruments in animal life, causing movements and sensation, the idea takes shape in our minds, as the motor response

to a sensory stimulus. It took a long time to make a precise formulation of this idea. It emerged in physiological terms, comprising the neuro-anatomical arrangement, as late as the 19th century. Prior to this some important observations had been made by *Leonardo da Vinci.* He had recognised the function of the pupillary reaction for admitting proportionately more light in dark conditions and less light in bright conditions. *Rhazes,* the Arabian Physician, had observed that the pupil reacts as it "feels the need for light." *Descartes* was the first to describe the Reflex action. I may quote the following passage from his writings:

"... If some one quickly thrusts his hand against our eyes as if to strike us, even though we know him to be our friend, that he only does it in fun, and that he will take great care not to hurt us, we have all the same trouble in preventing ourselves from closing them, and this shows that it is not by the intervention of our soul that they close, seeing that it is against our will, which is its only, or at least its principal activity, but it is because the machine of our body is so formed that the movement of this hand towards our eyes excites another movement in our brain, which conducts the animal spirit into the muscles which cause the eyelids to close."

Willis in the 17th century had a good conception of reflex action. He says 'that the impression of an object, driving the animal spirits inwards and modifying them in a certain peculiar manner, gives rise to a sensation and that the same animal spirits in that they rebound from within outwards in a reflected wave as it were, call forth the local movements."

Robert Whytt in the 18th century is believed to be the first to localise a reflex by showing, that the lasting dilatation of the pupil might be due to compression of the optic thalamus. He also showed, that the brain is unnecessary for reflex action, and that a portion of the cord suffices for this, for in a brainless frog the reflexes of the upper and lower limbs are in different parts of the spinal cord.

It was in the 19th century that the term and concept of reflex action became more significant. This was due to the work of *Marshall Hall* (1790–1857) and of *E. E. F. Pfluger* (1829–1910).

Pfluger distinguished the following laws of Reflex Action:—

Law of Homolateral conduction. If the stimulation of a peripheral sensory fibre is succeeded by unilateral muscular contraction, these occur exclusively on the side of stimulation.

Law of symmetrical Reflex action. Once the stimulation of a sensory fibre has elicited a unilateral reflex by way of spreading, excited the motor nerves of contralateral side, thus producing bilateral reflexes, only those motor mechanisms are thrown into action that are also active on the side primarily stimulated; bilateral reflexes are never produced in crossed direction.

Unequal reflex activity on both sides in bilateral reflexes. If the stimulus of a sensory fibre provokes reflexes on both sides of the body, so that reactions (spasms) are more intensive and more violent on one side, the more active muscles are on the same side as the stimulated sensory fibre.

Law of reflex irradiation. (a) Reflex irradiation in the brain. The roots of a stimulated sensory cranial nerve

and those of the motor nerve excited by the former are either about the same level or the motor nerve is situated more posteriorly than the sensory root. In the brain, reflex irradiation spreads from the primary reflex level to posterior regions, i.e., toward the medulla oblongata.

(b) Reflex irradiation in the spinal cord. In the spinal cord reflex, irradiation spreads from the primary reflex level to superior region, but never to inferior ones.

Law of the appearance of the Reflexes in three regions. Reflexes, unilateral or bilateral, appear without exception only in three regions of the body:

(a) The reflex appears in those motor mechanisms, that are at about the same level as the stimulated sensory fibres.

(b) If those motor mechanisms react, that are distant or even far distant from the level of the stimulated sensory nerves, the motor nerves excited always originate in the medulla oblongata.

(c) The reflex may involve, simultaneously or successively all of the muscles of the body.

It was the regional character of the reflexes which ultimately made the reflex actions fit for diagnosis. From then onwards they became an important factor in neurology. *Marshall Hall* considered *Haller's vis nervosa* to be the principle of reflex action.

Further development in this field occurred by the work of *Sir Charles Sherrington,* who conceived reflex activity as integrated or the outcome of the activity of the entire nervous system. He also stressed the purposeful nature of the reflex. This view had already been put forward by *J. Hughlings Jackson,* who distinguished the functional

deficiencies resulting from destroying lesions, and positive symptoms reflecting the remaining activities of the spared parts which he interpreted as the 'survival of the fittest' which meant purposeful activities. The reflex action is thus not aimless. As the result of injury or disease, those movements suffer first and most severely which are voluntary. The automatic movements on the other hand suffer last and less severely. The former are regained last or not at all, the latter are the first to be regained. This is in conformity with old observations regarding stroke and hemiplegia.

The ancient philosophers like *Aristotle,* were unable to understand the manifestations of a living organism without admitting some direction and organising principle (the soul) presiding over the living organism, its genesis, activity and reactivity, all of which reveal plan and purpose to the observer. This was the belief in the days of *Hippocrates* and Galen and also ancient Ayurveda. There was great belief in the healing power of nature. These views were adopted for many centuries. The mechanical interpretation of nature gained momentum in the 17th century through the philosophy of *Descartes,* who made motion the source of the Universe as well as of the human body.

The need for a psychological analysis of patients affected by brain lesion was stressed for the first time by *Freud* and reaffirmed by *Goldstein.* Further, a number of investigators were able to detect the variability of reflex activities in accordance with modifications to which the whole body was submitted. For example, the variability of dorsiflexion of the big toe, known as Babinski's sign, which occurred according to the variations in posture of

the leg, or the variability of the head, and vice versa.

Psychiatry and Neurology

It was in the 19th century, that the subject of Psychiatry was based on an anatomical and physiological foundation. During this period neurology also came into being as a separate discipline. This was due to the work of *Charcot* and his pupils, and Italian precursors of *Lambroso*. Psychiatry was included in the medical curriculum of the University and was taught in the medical colleges. Italy was the pioneer country, in which instruction in Psychiatry was made obligatory. Here there was *Cesare Lombroso* (1836–1909), one of the greatest teachers and investigators in this subject. His school at Turin became famous, and was highly esteemed by the members of the medical profession.

It was *Morgagni* who in 1760 put up the positive concept of insanity as an organic disease, intead of merely psychological and metaphysical.

Jean Martin Charcot (1825–93) in France was one of the greatest neurologists of his time. His most important neurological work was on cerebral localisation. He and his colleague *J. A. Pitres* (1848–1927) established the existence in man of cortical motor centres, previously worked out on the higher mammals. He also showed, that the lesion in poliomyelitis is in the anterior horn of the grey matter of the cord. He was equally well-known for his work and teaching on psychological states, especially hysteria.

Conditioned Reflex

The work on Conditioned Reflex was done primarily by *Van Petrovich Pavlov*, who was born in Ryazan in Cen-

tral Russia on 26th September, 1849. He died on 27th February, 1936.

He has been one of the greatest neuro-physiologists of modern times. His work on conditioned reflexes has been of great importance. It is the investigation of the physiology of cerebral hemispheres by the objective method.

Most of the reflex behaviour of an animal consists of innate responses, because the anatomical pathways are anatomically laid down in the nervous system of the organism to produce specific muscular reaction to particular stimuli. *Pavlov* was the first to demonstrate, that such naturally laid down nerve paths may be successfully modified. His classic experiment was the secretion of saliva. He made use of the fact, that saliva is normally secreted by the salivary glands in the mouth, when food is chewed or even food is seen or masticated. Under normal conditions no animal will secrete saliva in response to the ringing of a bell or to any other sound. But if a bell is repeatedly sounded simultaneously with the presentation of food for an adequate period of training, the animal will respond to it with the secretion of saliva, even when no food is presented at the time. By repetition and association the two stimuli produce impulses, which acquire a property of flowing in the same channels resulting in the same motor response. The secretion of saliva in response to food is an unconditioned reflex. The newly acquired reflex, the secretion of saliva in response to ringing of the bell is a conditioned reflex.

Conditioning is equivalent to learning. It shows, that whatever the form of natural and hereditary established desires or responses some modifications of them are possible, modifications due to environment in which the animal

is placed. According to *Pavlov* the development of a conditioned reflex is first of all a biological process, which creates the pre-requisite for proper metabolism and exchange of energy between the organism and the external environment. The nervous system plays a very important part in basic biological processes. Through conditioning it is possible to extend the effective range of environment vis-a-vis a specific response. Certain units of behaviour which are not hereditary can also be evolved in the same way and it is now believed that conditioned reflexes are largely responsible for the formation of behaviour and psychical phenomena of higher animals.

Concluding Remarks

In the last 20 or 30 years, neurology has reached a very advanced stage of development resulting in great benefits in the medical and surgical treatment of quite a number of nervous ailments. Neurology is also of considerable help in elucidating medical problems in bio-chemistry, metabolism, organic integration and particularly, in psychosomatic and psychiatric nosology. There is still a vast field for investigation, the unexplored areas of the human brain and especially the hypothalamus, which with the pituitary, adrenal and thyroid glands may be connected with many endocrine, neurologic and psychiatric problems. These need further investigation, which would give very promising results.

Finally, may I remind you of the prophetic words of *Sir M. Foster* which he uttered at the commencement of the 20th century:

"It is one of the lessons of the history of science, that each age steps on the shoulders of the ages, which have

gone before. The value of each age is not its own but is in part, in large part, a debt to its forerunners. And this age of ours, if like its predecessors, it can boast of something of which it is proud, would, could it read the future, doubtless find also much of which it would be ashamed."

There is one important lesson that we can all learn from all this discussion. And that is the virtue of Humility. In the search of Truth, especially scientific Truth, there is need for great dedication, perseverance and Humility on the part of the investigators, especially Humility. Humility and again Humility.

X

THE RENAISSANCE AND THE EVOLUTION OF MEDICINE*

I consider it a great honour to have been invited to deliver this extra-curricular lecture on the History of Medicine at the Armed Forces Medical College, Poona. I am sincerely grateful to Lt. Gen. C. C. Kapila, Director General, Armed Forces Medical Services, and to Major General P. N. Bardhan, the Commandant of the Armed Forces Medical College, Poona for the kind invitation.

It is a great pleasure to me to be amongst you this morning, for I have spent a large part of my career amongst the students and staff of Grant Medical College, Bombay.

In dealing with the subject of History of Medicine, I have selected the subject *'The Renaissance and the Evolution of Medicine,'* specially for the reason, that it will give us some idea as to how the present phase of the growth of Medicine has come about.

The Renaissance indicates the movement in Europe, which divides the medieval from the modern world. It occurred approximately in the period 1500 to 1700 A.D. This was a gradual change. Human beings are slower to change than we are apt to imagine. Yet, the broad contrast between the medieval and modern age emerges suffi-

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* Based on an address delivered at the Armed Forces Medical College, Poona, on 28th July 1964.

Reprinted from the *Armed Forces Medical Journal* Vol. XXI No. 1, 1964.

ciently plainly. A society divided between the lay and the cleric, as was the case in medieval times, gave place to one, which was divided between the rich and the poor. An atmosphere hostile to free enquiry gave place to one in which Science could live and flourish. During the early middle ages the church was the sole repository of culture. The use of Latin was universal amongst the educated classes, and Latin was the Lingua Franca of Western Europe. The thinking in Europe, whether in schools or colleges or outside them was carried on by the direct influence of the Christian Church. Old knowledge was static, and new knowledge was not acquired. The political theory of the middle ages was shaped by the surviving prestige of the Roman Empire, and the over-powering authority of the Roman Church.

EARLY HISTORY OF MEDICINE

In order to get a correct picture of what happened during and after the Renaissance, it would be appropriate to refer briefly to the conditions, which prevailed prior to it.

I. Medicine in the Early Stages

Medicine is as old as Civilization itself. It is the oldest of sciences. Pain, fever and death were mysteries, which excited the curiosity of man in the prehistoric days. A sick man cried for help and some means had to be discovered to relieve him of his agony. Medicine is part of the general culture of the human race, and its history is part of the history of civilization.

(i) *Ayurvedic Medicine*:

In India, we had the Ayurvedic system of medicine which can be traced back to about 3000 B.C. The ancient

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writers of medicine here have described medicine as the gift of God. Dhanvantari is the divine guardian of classic medical wisdom. He is said to have arisen from the liquid depths of primeval cosmic life-substance carrying the elixir of immortality in a milk-white bowl. As the embodiment of Hindu medical wisdom, Dhanvantari is allied with the divine maintainer of the Universe, Vishnu. Ayurveda, or the science of life, is said to be bestowed by Indra on Bharadwaja, who was deputed to go to him by the Assembly of sages, who met in the Himalayas. Atreya, the great sage, probably a pupil of Bharadwaja, was a great teacher of Medicine. Agnivesa, the distinguished pupil of Atreya, undertook the Herculean task of codifying the knowledge imparted by Atreya and to arrange it in the form of a treatise, which formed the basis of *Charak Samhita*. Charak was a great physician, who wrote the immortal *Charak Samhita*. The other great Indian Medical classic is the *Sushruta Samhita*, written by Sushruta, the celebrated surgeon. This contains a great deal of surgery, in which the ancient Indians excelled. They set fractures, performed amputations, repaired Hernias and did couching for cataract. They did the operations of Rhinoplasty and Lithotomy. Hygiene played a great part in Indian medicine. The Laws of Manu are important from the medical point of view, as they enjoin strict personal hygiene, and frequent ablutions as the basis of religious worship. The Ayurvedic medicine had reached a high level of development in the old days. At Taxila and Nalanda, there were very famous Universities. They were great centres of learning, where among other subjects, Medicine was also taught. They attracted students not only from India, but also from many neighbouring countries.

The Ayurveda reached the height of its glory during the period of the Maurya empire in Indian history. It made some progress during the Gupta period, but after that it became static, and there were definite signs of decline afterwards.

Even before the arrival of Aryans is Nothern India medicine and especially hygiene had developed considerably as indicated by the excavations at Mohanjodaro. Subsequently Buddhism contributed a great deal to its development. Asoka (226 B.C.) and other Buddhist kings established public hospitals for men and animals as well as schools for medicine. This was in accordance with the injunction of Buddha, namely "*Who-so-ever would wait on me should wait on the sick.*" Charak was the court physician of the Buddhist king Kanishka. Nagarjuna, the well known Buddhist sage, infused new life into the science of Ayurveda. To his lofty intellect and wise scholarship, India owes the revised edition of *Sushruta Samhita* now in use. The latter part of Sushruta's treatise, which bears the name of Uttaratantra is entirely the result of Nagarjuna's independent research and thought. Vagbhata, a Buddhist, is the author of another book on Ayurveda, which is studied even today as a standard textbook.

It is not unlikely that Ayurvedic medicine influenced Greek medicine. At the time of Alexander's Indian expedition (327 B.C.), Hindu physicians and surgeons enjoyed a great reputation for superior knowledge and skill, and he took some of them with him to Greece. When Asoka ascended the throne in 270 B.C., he was largely influenced by Buddha and his teachings. This great monarch had contacts with the kings of Syria, Egypt, Macedonia, Ceylon and other countries. Megasthenes was sent as an Am-

bassador from Greece to the court of Chandragupta, King of Magadha. Thus the culture of India spread to other countries, including the knowledge of medicine in India.

Medicine had also progressed a great deal in Babylon and Egypt as well as China, but today I shall refer particularly to medicine in Greece and Rome.

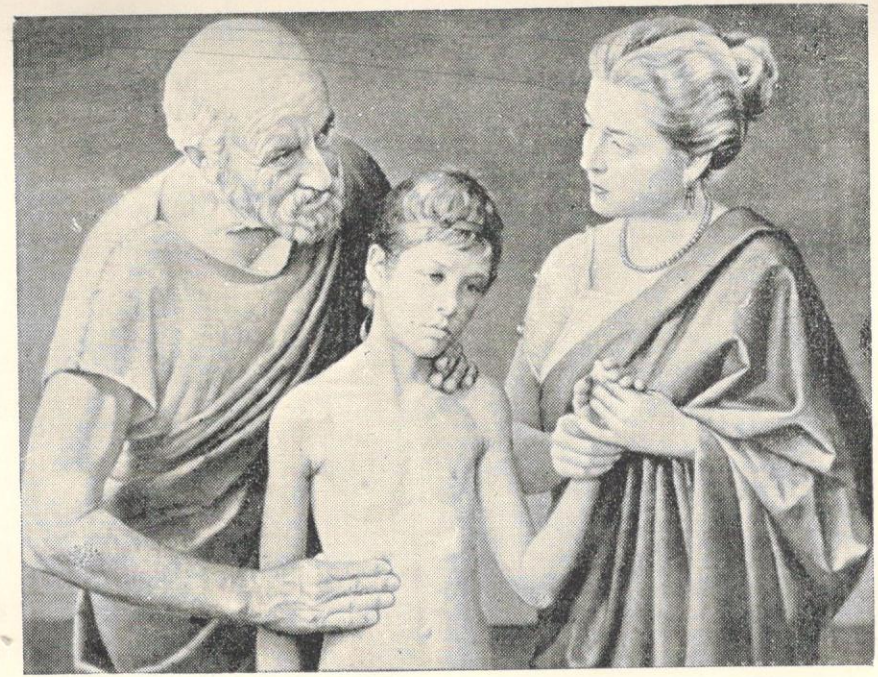
(ii) *Medicine in Greece:*

In ancient Greece, medicine was originally regarded as a gift of God, as in India. Apollo was known as the God of Health. The Greeks' attitude to life became more and more rational and this influenced their attitude towards disease and the science of medicine.

The greatest physician in Greek medicine was Hippocrates, who is known as the Father of Medicine. He was a contemporary of Plato and was born in 460 B.C. on the island of Cos and died probably in 355 B.C. His teachings are contained in "Corpus Hippocraticum," which deals with various medical subjects. He made an attempt to deal with medicine in a rational way, and said that the most important thing in the practice of medicine is observation. He sums up the duties of the physicians:

> "Consider the past, diagnose
> the present, foretell the future.
> Practise these arts. As to the
> decisions, make a habit of two things —
> to do good, or at least to do no harm."

His greatest contribution was the introduction of Ethical principles. The famous Oath of Hippocrates still forms the basis of Ethics of the medical profession all the world over. He brought dignity to the practice of medicine.



HIPPOCRATES

After Hippocrates came another great man, Aristotle, who was a pupil of Plato. Like Hippocrates he insisted on scientific method in studying matters relating to health and disease. After Aristotle, the glory of Greece began to fade. The Hippocratic tradition moved to Alexandria in Egypt, where a medical school was established. Here the sciences of Anatomy and Physiology were studied.

(iii) *Medicine in Rome*:

By the first century B.C. the centre of civilization gradually shifted from Greece to Rome. But the medicine in Rome was Greek Medicine and all the great physicians in Rome were Greeks. The greatest figure in Graeco-Roman medicine after Hippocrates is Claudius Galen, who was born in the town of Pergamus in A.D. 131. He studied medicine at Alexandria. He also visited Greece. In A.D. 162 he came to Rome, when Marcus Aurelius was the Emperor, and Roman civilization was at the height of its glory. Galen codified all Greek and Roman medicine and made contributions of his own. His writings were standard books in medicine for centuries. His authority remained supreme during the next 1200 years. He died in A.D. 200.

After the Greek Empire broke up, its culture was first continued in Alexandria and then at Rome. When Roman Empire broke up, the culture disappeared from Europe for a thousand years. After the death of Marcus Aurelius the Roman Empire began to crumble and Rome itself became untenable. The seat of government was transferred to Constantinople and with it went the science of medicine. The medical schools disappeared. The Greek manuscripts were lost or destroyed. Medicine was no longer a science. Christianity, however, had a wholesome influence and it was in the monasteries that learning survived.

The monasteries also offered sanctuary and hospitality to the poor, the needy and the sick. Thus the monastery also became a hospital. Under the influence of Christianity many hospitals were established.

(iv) *Medicine in Arabia*:

While in Europe, medicine as a science was at a standstill, the light of knowledge had not altogether extinguished in other parts of the world. Many of the works of Hippocrates and Galen and other Greek physicians were safely evacuated to Constantinople, where they were carefully preserved. From there, the medical knowledge spread to Mesopotamia. Baghdad was the centre of Arab culture, where the enlightened Caliph Harun-ul-Rushid ruled. He founded there a University, a hospital and a medical school. The books of Hippocrates and Galen were translated into Arabic. The Arabs, who were inspired by the teaching of Holy Prophet Mohammed, became the torch-bearers of learning and culture. Two Arab physicians were outstanding, namely Rhazes and Avicenna. They played an important part not only in introducing Greek (or Unani) medicine in Arabia, but also in the revival of learning in Europe and Asia. Rhazes was born in A.D. 860, in the Persian town of Rai. He wrote a five volume Medical Encyclopaedia. Avicenna wrote the "Canon of Medicine" which was used as a textbook in the European Medical Schools till after the Renaissance.

From Arabia the Muslim influence spread to the west and the east. On the Eastern side it spread to Persia, Afghanistan and India as the *Unani* System of Medicine. In India it flourished in certain centres, notably in Lahore, Lucknow, Hyderabad (Dn.), Aligarh and Delhi. Even today there are many votaries of this system and it is

practised in many parts of the country. Thus in India we have had the Ayurvedic and Unani systems of medicine for many centuries.

II. Medicine in the Medieval Period (1096–1438)

The Mediaeval Age was the period of feudalism and ecclesiasticism, and in Learning (including Medicine) there was obedience to authority. Even before the downfall of the Roman Empire in the West, there was collapse of the Greek Philosophy. For centuries, the social history of Europe was its rebuilding and the organisation of nations from various loose tribal groups. At that time the greatest need of the European society was spiritual uplift, rather than intellectual development. Under the circumstances, the Christian Church, with its spiritual appeal made a wonderful contribution. The growth of the Christian virtue of compassion towards the sick and suffering led to new departures in Medicine, particularly in nursing the sick and erecting hospitals for their care and treatment. There was, however, absolute suppression of experimental science and independent enquiry. There was surprising ignorance of Hippocrates and his teachings; but Galen and his writings were supreme. Avicenna and his writings which were translated from Arabic into Latin were also read by the physicians.

According to Neuberger, history of medieval medicine in Europe may be divided into 4 periods:—

(a) *The Monastic Period* (5th to the 10th century)

During this period, there was praiseworthy zeal for preserving the remains of ancient literature and traditions. There grew up a cult of faith healing or theurgic therapy. Western medicine went into eclipse, and its practice be-

came as rudimentary and stereo-typed as that of the primitive man.

(b) *Salernitan Period* (11th & 12th centuries)

The school of Salerno then came into existence. Salerno is a little sea-side town near Naples. It was known as the ideal health resort. The Medical School here became famous during the medieval times. The teachers here were the first medieval physicians to cultivate medicine as an independent branch of science. Here the spirit of ancient Greek medicine still prevailed and it may truly be called *'Civitas Hippocratica.'*

(c) There was influence in Salerno of Arabian Medicine also dating from the conquest of Sicily and Southern Italy by the Moslem power (827–884 A.D.) A book "Regimen Sanitatis Salerni," dealing with popular medicine was written at this school, which added greatly to its reputation. The Islamic influence lasted till the 13th century.

(d) *The Pre-Renaissance Medicine* (14th & 15th centuries)

During the 14th and 15th centuries, medicine was characterised by an attempt to cast the Arabian tradition into Aristotelian philosophy, with the result that the Galenic doctrine after translation and retranslation through the Arabic, Syrian and Hebrew texts was badly distorted and lost much of its original meaning. The medical literature of this period was entirely passive, consisting of compilations, commentaries etc.; but no original contributions were made.

III. Renaissance

The 16th century may be regarded roughly as the first stage, when a change was noticeable, although some indi-

cation of the change had occurred in the previous century. The close interrogation of nature, which was to lead to the development of modern science had begun. Painters examined the human frame, and surgeons dissected it: Verrochio the sculptor, was also an Anatomist. The discovery made by Copernicus, a Polish Astronomer, that the earth revolved round the sun, steadily gained adherents. A new culture, lay in its outlook and aristocratic in origin, for it chiefly grew in the courts of the Italian rulers, spread widely through the invention of printing. As Professor H.A.L. Fisher, the Oxford Historian, says:

> During the Renaissance, "Europe turned away from the vast literature of commentaries and glossaries, which the pedants of the later middle ages had inscribed in letters of opium on tablets of lead."

There was a spirit of adventure abroad. The Portuguese conquered Ceuta on the African coast in 1415, and then Vasco da Gama set sail on the 8th July 1497 and by circumnavigation of Africa arrived at Calicut in India on 20th May 1498. Christopher Columbus, the Genoese sailor, discovered in 1492 the new world beyond the Atlantic. The Mediterranean ceased to be the centre of civilized world. By degrees Europe began to enter into the new phase of its existence, which is distinguished by the establishment of colonies and empires beyond the ocean, and by the gradual spread of European culture and influence throughout the habitable globe. In this adventure at first Portugal and Spain, and then the Netherlands, France and England took an active part.

The discovery of the new world coinciding with the printing taught that "Truth," as Roger Bacon said, "is the daughter not of authority but of time." Thus mankind

acquired a new attitude towards knowledge. Authority no longer went unchallenged. The past was no longer supreme, and generations grew up for whom 'Truth' was not necessarily all that was given in ancient books, but something which should be ascertained by direct objective study and observation.

Under such circumstances, when Europe was kindled by new knowledge and new outlook, there came Protestant Reformation. This was a challenge to the Roman Church. As a result of this, a religion widely held and strongly entrenched in the social and political tradition of Western Europe was challenged by new spiritual forces, and over a large part of Europe it was compelled to accept defeat. Views of life based on freedom of thought and upon the right of the individual conscience came into prominence, which in the long run transformed the institutoins of Europe and shaped the life of the modern world. Never was the human mind so widely and sensibly affected as in the 17th and 18th centuries as the result of the Renaissance.

From the point of view of evolution of Medicine, the period which is of the greatest interest to us is the middle of the 16th century. It was then that the Medici who stood close to the people and understood their needs were established in Florence. The Protestant Reformation was steadily spreading. Martin Luther was preaching his doctrines. Art, was flourishing. The Artists like Raphael, Michael Angelo and Titian were infusing the new spirit. The new learning was everywhere working like leaven. The old Universities were expanding and new ones were springing up everywhere. Nicholas Copernicus had laboured hard to study the ancient science of Astronomy.

The art of printing was steadily contributing its share of pouring forth the means of knowledge.

The Renaissance produced the double phenomenon of a return to the classic past, and revival of the dignity of the individuality of the human being in addition to the critical spirit springing up in the Arts, Science and Literature. There was a great desire for the freedom of thought and expression.

The Christian viewpoint, which considered disease as the punishment for sin, gave way to the old Hellenic conception, according to which disease is a disharmony in the body, which nature should cure. The sentiment, which made it a sacrilege to dissect dead bodies, as they were considered impure, gave place to the thought that by the actual study of the human body itself could one know its perfect beauty. So the Artists and the doctors considered, that they should make an intensive study of it.

This renaissance appeared in different ways in different countries. In Germany and the North, Luther and Paracelsus appeared on the scene. In Italy it was pivoted on men like Machiavelli and Guicciardini, profound historians and politicians of the age. In medicine, it was in Anatomy that the revolution was brought about by Andreas Vesalius.

A. Castiglioni, the well known Italian medical historian, describes the influence of the Renaissance in the following words:

> "In this marvellous period of Renaissance, which marks the return to the ancient concepts of Hellenism, in philosophy as in Art, in Medicine as in Literature, vivid sparks emerged from the forge in which the new forces of the world were being tempered. Disencumbered from

the rigid structure of scholasticism, the horizon revealed the striking profile of the new science, founded on the free, critical and individualistic philosophy of Hippocrates and nourished by the new investigations and gifted observations of the men of the Renaissance, guided no less by ancient traditions than by the firm desire to engrave deeply their own record in the pages of history."

(a) *Andreas Vesalius* (1514–1564):

It was under such circumstances, that in the year 1543, the printing press of J. Oporinus in Basle published a book "Fabrica Humani Corporis" (the structure of the human body) by Andreas Vesalius, which has been described by Sir William Osler as *"The greatest book ever printed from which medicine dates."* It served as the basis of Medical teaching for centuries afterwards.

Who was Andreas Vesalius? He was a Belgian born at Brussels in 1514. His father was apothecary to Charles V. His mother was probably of English extraction. When still young he was interested in Anatomy and dissected animals like mice, rats, cats and dogs. The young Vesalius went to school at Louvain and afterwards entered the University there. In 1533 he went to study medicine at Paris. Here he worked under two eminent teachers, namely Jacobus Sylvius and John Guinterious of Andernach. Sylvius at that time had already achieved great reputation, and drew students from all parts of Europe. The teaching of Sylvius however still chiefly consisted of reading of the books of Galen. Occasionally the body of a dog or a corpse from the hospital was brought into the lecture room and barber attendants were employed to dissect them for demonstration to the students. Sylvius himself did not do the dissection. Vesalius was not satisfied with this;

and one day, he put the ignorant barbers on one side and himself completed the dissection. He says:—

"My study of Anatomy would never have succeeded, had I when working at medicine at Paris been willing that the viscera should be merely shown to me and to my fellow students at one or another public dissection by wholly unskilled barbers, and that in the most superficial way. I had to put my hand to the business."

Vesalius assisted Guinterious in preparing his book *Institutiones Anatomicae.*

In those days, complete dissection of the human body was impossible, as it was prohibited by the church. Vesalius used to visit the burial ground attached to the Church of Innocents in Paris, and there he studied bones of the human body for many hours. He also went with another fellow student to another burial ground on what is now "*Les Buttes Chaumont*" to study the bones.

After three years he went from Paris back to Louvain, where he continued to study Anatomy. In 1537 he went to Venice and the same year he was given the Doctorate of Medicine by the University of Padua. Padua was an enlightened seat of learning and was following the Arts and Sciences in all possible ways. It was here that Galileo Galilei (1564–1642) carried out his observations in Astronomy with the help of a new instrument, the telescope, which he designed and thus laid the foundation of a new era of experimental scientific studies. Vesalius was appointed Professor of Anatomy and Surgery there in 1537 and was entrusted with the duty of conducting dissections. He began to teach Anatomy in his own way. He did dissection with his own hands, and ultimately taught only

what he could himself see in the structure of the body of man, and not what Galen had written. In Padua the church was not so strong as in Paris or Louvain or in Spain. Here he was able to get dead bodies for dissection. In 1542 after 5 years hard work, he wrote *Fabrica Humani Corporis* (Structure of the Human Body), illustrated with many diagrams, which was published by Oporinus in Basel in 1543. It contains description of the structure of the human body as he had himself seen. The artist, Johann Stephen van Calcar, a countryman of his, made all the illustrations in this book.

This book, *Fabrica Humani Corporis*, is the beginning not only of modern Anatomy, but of modern medicine as well. It was a great landmark in the history of medicine. The subsequent history of Vesalius is rather tragic. His book raised a great storm. After publication of the *Fabrica*, Vesalius who had already lectured at Bologna and Pisa returned to Basle, where he prepared a skeleton which is still preserved. A number of editions of this book appeared.

Sylvius, his former teacher, opposed him, while Realdus Columbus and other Anatomists also attacked him.

Under these unhappy circumstances, he left Padua and became Court Physician to Emperor Charles V at Madrid in 1546, and subsequently to his successor Philip II in 1556. Here he had no opportunity to pursue his anatomical studies. In 1563, he undertook a pilgrimage to Jerusalem, perhaps to expiate for the sins he had committed by dissecting human bodies. On his return journey, his ship was wrecked at Zante, and he was stricken by a severe illness, probably typhoid, and he died in 1564. He was scarcely 50 years old at the time.

The achievements of Vesalius in Anatomy were truly

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The achievements of Vesalius in Anatomy were truly

great. His book *De Humani Corporis Fabrica* is a document of the highest rank in the history of medical science. Vesalius occupies a foremost place in the history of Medicine both as an inaugurator of the science of Anatomy, and also as the founder with William Harvey of modern Medical Science based on facts rather than tradition.

In addition to Andreas Vesalius, I shall refer briefly to Galileo, William Harvey, Leonardo da Vinci, Thomas Linacre, Thomas Sydenham and Paracelsus, who were great pioneers who ushered in the new spirit of enquiry, which is the characteristic feature of the Renaissance.

(b) *Galileo Galibi* (1564–1642):

He was essentially a Mathematician. His influence on Medicine was indirect, as he laid great stress on exact measurement. For some time he studied Medicine at Pisa, but after a time he gave this up, and stuck to Astronomy and Mathematics. He constructed Telescope, and also a primitive microscope, which achieved great importance in the study of Medicine.

(c) *William Harvey* (1578–1667):

William Harvey was greatly influenced by the experimental spirit practised by Galileo. It helped him to demonstrate that the blood moved in a circle.

William Harvey was born in Folkestone in April 1578. He joined Gonville and Caius College, Cambridge, in 1593, and obtained his degree in Arts in 1597. The following year he left England to study medicine at Padua, which was a great seat of learning in those days. He spent about 5 years there, and in 1602 received the degree of Doctorate of Medicine there. On his return to England, he was awarded the degree of Doctorate of Medicine by the Uni-

versity of Cambridge. He set up his practice in London and in 1609 was appointed physician to St. Bartholomew's Hospital. He was then developing his ideas, by actual experiment, regarding the movements of the heart and of the blood. In 1628 his book *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animali* was published. He attained great fame and favour at the Royal Court and became physician to King Charles I. In 1646 he retired into private practice. In 1651, he published his treatise, *De Generatione Animalium*, and on 3rd June 1667 he died, and thus ended a life remarkable for its achievements and its effects on further progress of medicine.

His great achievement was the demonstration of the circulation of blood by means of vivisection and ocular inspection which he described in his famous book *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animali* (1628). He gave a clear conception of the work of the auricles and ventricles, with their respective valves. He gave a truer conception of the pulmonary circulation and of general circulation than was ever grasped before. He conjectured that in the tissues blood passed from Arteries into Veins. The existence of capillaries was not known at that time. This knowledge came subsequently with the discovery of the microscope. I shall quote Harvey's own words:—

> "I frequently and seriously be-thought me, and long revolved in my mind, what might be the quantity of blood which was transmitted, in how short a time its passage might be effected, and the like; and not finding it possible that this could be supplied by the juices or ingested aliment without the veins on the one hand becoming drained and the arteries on the other hand

becoming ruptured through the excessive charge of blood, unless the blood should somehow find its way from the arteries into the veins, and so return to the right side of the heart; I began to think whether there might not be a motion as it were, in a circle.

"Now this I afterwards found to be true; and I finally saw that the blood, forced by the action of the left ventricle into the arteries was distributed to the body at large, and its several parts, in the same manner as it is sent through the lungs, impelled by the right ventricles into the pulmonary artery, and that it then passed through the veins and along the vena cava, and so round to the left ventricle in the manner already indicated, which motion we may be allowed to call circular."

Harvey's idea was that blood in the body moved in a circle. This was confirmed again and again subsequently by new facts which were discovered. Harvey says:—

"Since all things, both argument and ocular demonstration, show that the blood passes through the lungs and heart by the action of the ventricles, and is sent for distribution to all parts of the body, where it makes its way into the veins and pores of the flesh, and flows by the veins from the circumference on every side to the centre, from the lesser to the greater veins, and is then finally discharged into the vena cava and right auricle of the heart, and this in such a quantity or in such a flux and reflux, thither by the arteries, hither by the veins, as cannot possibly be supplied by the ingesta, and is much greater than can be required for mere purposes of nutrition; it is absolutely necessary to conclude that the blood in the animal's body is impelled in a circle, and is in a state of ceaseless motion,

that this is the act of function which the heart performs by means of its pulse; and that it is the sole and only end of the motion and contraction of the heart."

The greatest name after Andreas Vesalius is that of William Harvey. He was a true scientist. He adopted the scientific method for his investigations. The work of Vesalius and Harvey laid the foundation of Anatomy and Physiology and changed the whole basis of medical science.

(d) *Leonardo da Vinci* (1452–1519):

He was one of the greatest Artists, who was a harbinger of the Renaissance. He was a great genius who combined in himself the qualities of an artist and a scientist, including sculptor, architect, geologist, physicist, mechanical engineer and a biologist. It is said, that "his was the grandest effort ever made by any man to explore and interpret the universe." He was the initiator of the new era in anatomical and physiological studies. Leonardo performed many dissections on the human body. He had a marvellous anatomical technique. He used injections into the veins, liquid wax in arteries and made gross serial sections to study structures of the body, and above all drew beautiful diagrams of the appearances he observed. He studied muscles and bones, made sections of the brain, traced the cerebral veins, and other aspects of Anatomy.

Although he showed accomplishment in the subject of Anatomy and wrote down all that he had done, his work did not attract much attention at the time.

(e) *Thomas Linacre* (1460–1524):

Thomas Linacre was born at Canterbury. He was a Greek scholar. On the advice of his friend William Tilling of Selbing, he went up to Oxford and joined Canterbury

Hall, afterwards known as Christchurch, and studied classics. At the age of 24 he went to Italy and visited Florence where he met Lorenzo the Magnificent. He then returned to Oxford and took up the study of Medicine, so that eventually he became a great classical scholar and a physician. From King Henry VIII, he obtained letters patent for the establishment of a body of picked medical men, which later became the Royal College of Physicians of London. This College, was empowered to examine and to issue licence to physicians and to decide who should be allowed to practice medicine in the City of London and its immediate neighbourhood. The first President of the Royal College of Physicians was Thomas Linacre himself, a very suitable person for that position. He died in 1524.

(f) *Thomas Sydenham* (1624–1689):

He was a great clinician, and paid great attention to the observance of signs and symptoms of disease. He gives very vivid descriptions of many ailments, which are as accurate as those of Hippocrates. In fact he was a great exponent of the Hippocratic method. He introduced the use of iron in cases of Anaemia, of Cinchona bark from Peru in Malaria, and of Mercury in Syphilis. His appearance at this juncture was very opportune, when physicians were deeply immersed in various theories and philosophical speculations.

(g) *John Caius* (1510–1573):

He was one of the fuonders of Gonville and Caius College, Cambridge. He went to Padua to study medicine. After his return to England from Padua in 1546 he was appointed Reader in Anatomy to the Guild of Barber-

Surgeons, and held this post till 1563. He succeeded Linacre as the President of the Royal College of Physicians, and also became Master of Gonville and Caius College, Cambridge. He was a prolific writer, and raised the status of the Medical profession.

(h) *Paracelsus* (1493–1541):

There was increasing tendency during the Renaissance for the authors to write in their own languages (French, German, English and Italian) than in Latin. This helped to get men's minds away from scholasticism and turn them towards realities and facts of life. There were four great leaders of the 16th century who helped the advance of medicine, namely Paracelsus, Vesalius, Harvey and Pare. *Paracelsus*—(Theophrastus Bombast von Hohenheim) (1493–1541) was the most original medical thinker of the 16th century. He was a native of Switzerland (Einsieldeln, near Zurich), and was the son of a learned physician, with whom he began to study medicine. He got his doctor's degree at Ferrara (1515) and also acquired knowledge of alchemy and astrology from the bisbops and aboots. He taught medicine at Freiburg and Strassburg (1525). In 1527, he was appointed Professor of Medicine at Basel. He was a devoted follower of Hippocrates and strong opponent of Galen. It is said, that he began his campaign of reform by burning the works of Galen and Avicenna in a bonfire, and lecturing in German out of his own experience. He was a picturesque man. He was one of the alchemists, but he also enquired into the properties of metals, nature of drugs, vegetable and mineral, and their actions as remedies in disease.

IV. The Early Microscopists

The Microscope which was first invented by Galileo was not very effective. But it was subsequently developed with a compound system of lenses, and was an invention of the first magnitude in the progress of medicine. In this connection, I shall refer to Malpighi and Van Leeuwenhoek.

(a) *Malpighi* (1628–1694):

Marello Malpighi was a Professor at Bologna University. He is famous for his observations on capillary circulation in the lungs of the frog. This added the missing item in Harvey's otherwise complete account of circulation of blood. He was also a pioneer in the study of Embryology and made contributions to the subject of the development of the vascular and central nervous systems.

(b) *Van Leeuwenhock* (1632–1723):

He was a Dutchman, who developed the Microscope and confirmed Malpighi's observations on capillary circulation. He demonstrated the movement of blood corpuscles in their passage through the capillary network of a tadpole's tail. He was an expert in grinding lenses and his microscope was superior to any invented so far. From the medical point of view his most important discovery was that of bacteria and protozoa. His observations on micro-organisms link up eventually with the brilliant researches of Pasteur and ultimately with the bacteriological discoveries of the 19th and 20th centuries. Thus we see that no one in science or medicine works alone, isolated, as it were, from the past and the future. We are all constituents of a team work on a vast scale.

V. The Study and Practice of Medicine in the Renaissance

During the Renaissance, the study and practice of medicine passed steadily from the hands of the clergy to the lay people. There was great improvement in the economic and social position of the physicians. The physicians received their education generally in the Universities. The Universities in Italy were at the height of their fame in the 16th century. Of these, Padua was the best, and attracted students from Germany, England, Belgium, Holland, Poland, Hungary etc. Here there was complete religious freedom. Many famous Europeans as I have mentioned studied at that University, namely Copernicus, William Harvey, Caius and so on.

The teaching in the 16th century was still of the classic type. They all read Galen and Avicenna, but new orientations made their headway. Public dissections were practised, and gradually the teachers did their own dissections instead of asking their barber assistants to do it. The first Anatomical Theatre was built at Bologna and the second at Padua by Fabricius. The teaching of Pathology also began in this century in Padua.

Military Medicine occupied special attention. Military Hospitals were established at several places. The great progress in surgery in France is due to *Ambroise Pare*, who was a Military Surgeon. The increased use of firearms gave an impetus to the development of surgery.

The physicians during the Renaissance became scholars. Prior to this in the middle ages most medical practitioners consulted Astrology. Empiricists, Charlatans, Barbers and Farriers flourished in Europe. But now a change took

place. Now the great physicians were well versed in classical literature and were Humanists and very respected members of society.

The history of Renaissance is closely connected with Art. Anatomical progress was undoubtedly due to a large extent to the part played by the Artists. I have referred to the work of Leonardo da Vinci in this respect. There was also Michaelangelo, who was a pupil of Realdo Colombo. The anatomical plates in Vesalius's book were drawn by Calcar, who was a pupil of Titian. Raphael himself was a great student of Anatomy.

VI. The Renaissance and Modern Age

Thus we see that in Europe a profound change took place in the 15th and 16th centuries, when there was a transition from the Middle Ages to Modern times. The Renaissance commenced in Italy and spread over the continent of Europe. It was a new spirit, a new desire for knowledge and progress, which affected every sphere of life. Unquestioning acceptance of authority, the authority of the written word, gave way to criticism and experimental enquiry, and Medical Science which had scarcely progressed since the days of Hippocrates and Galen was quickly enriched by new discoveries.

Then there followed centuries of progress due to the work of reformers, who were inspired by the spirit of the Renaissance.

Thomas Sydenham in London and Hermann Boerhaave in Leyden (Holland) were great teachers of clinical medicine, who stressed the need for observation and careful examination of the sick person more than anything else.

On the surgical side there were William Chiselden, Percival Pott, William Hunter and John Hunter. Percussion was introduced by Leopold Auenberger, Stethoscope by Laennec, Vaccination by Edward Jenner. The most merciful of all discoveries was the conquest of pain and the introduction Anaesthetics, so that surgery became painless.

The discovery of the microscope, as I have mentioned, marks an important landmark in the history of medicine. It made the discovery of microorganisms possible. Rudolf Virchow using the same instrument found, that the human body consisted of cells; and this revolutionised the Science of Pathology. But the greatest scientist of the 19th century was Louis Pasteur, a Frenchman who was born in 1822. He was not a physician, but a chemist. He discovered the true nature of the process of fermentation, namely that it was caused by living organisms. He discovered the nature of immunity and was the first to cure people bitten by mad dogs. His influence can be detected even today. His work on microorganisms has laid an entirely new foundation for the practice of Medicine and Surgery, and has specially made a great contribution to Preventive Medicine.

I must also mention the name of Robert Koch, a German, who was born in 1843. He discovered the Cholera Vibrio and the Tubercle Bacillus. Another Bacteriologist, Metchnikoff, a Russian, who came under the influence of Pasteur, discovered the body's natural armour against disease—i.e., Leucocytes of the Blood. His theory threw new light on the nature of the infection.

The credit for applying Pasteur's discovery of microbes to the domain of Medical Science goes to Joseph Lister, who was born in 1827. By using carbolic acid as an anti-

septic in Operative Surgery he made surgery safe. He is rightly known as the father of Antiseptic Surgery, which has led to aseptic surgery in our times. Lister was a great personal friend of Pasteur. I may narrate the following incident which is well-worth recording:—

The scene was Paris (1892) the occasion the seventieth birthday of Louis Pasteur. Amid tumultuous applause France's greatest scientist was escorted to the platform by the President of the Republic. Many were the orations that followed, and extravagant the praises; but none of these could have meant more to Pasteur, than this simple tribute from an Englishman:

Lord Lister said:—

"Truly there does not exist in the wide world an individual to whom medical science owes more than you."

It was not the words that mattered, but the man who spoke them.

'The future' asserted Pasteur in his reply, 'will belong to those, who have done most for suffering humanity. I refer to you, my dear Lister.'

VII. Introduction of Modern Medicine in India

This took place as the result of our contact with the nations of the West. Prior to this we had the Ayurvedic and Unani systems of Medicine, as I have already mentioned. They still prevail.

(a) *The Portuguese*:

For the discovery of the sea route to India, Vasco da Gama sailed from Portugal on 8th July 1497. His expedition consisted of 4 ships. After navigating round the Cape

of Good Hope he reached Calicut (in India) on 20th May 1498. This was followed by other expeditions. In due course the Portuguese established a hospital at Goa. One outstanding medical personality of the early days here is Garcia da Orta, who was a doctor of Medicine of the University of Alcala and Salamanca, and for sometime Professor of Philosophy in the University of Lisbon. He came to Goa in 1534 and practised as a physician there for nearly 30 years. He was a great Botanist and wrote a book on "Conversations about Herbs and Drugs." He died in 1570. The instruction in medical science was first started in Goa in 1687. This continued for many years. This was probably the first institution in Asia, where modern medicine was taught. It was remodelled by Dr. Lima Leitao in 1819 and eventually became the "Escola Medico-Cirurgica" of Novo Goa in 1842. It trained doctors not only for Goa but also for other Portuguese colonies overseas.

(b) *The French* also established hospitals in Pondicherry and other colonial possessions. But the main contribution to the introduction of modern medicine in the entire country was made by the British.

(c) *The British*:

The first fleet of the East India Company under the command of Captain (later Sir James) Lancaster set out for the East in December 1600 with four ships. Each ship carried "Surgeons Two and a Barber." These "Surgeons Two and a Barber" were the pioneers who brought Western medicine to India. They constituted the origin of what subsequently developed into the Indian Medical Service, to which I had the honour to belong.

The history of the I. M. S. dates back to 1612, when it

was started by the East India Company under John Woodall as the first Surgeon General. Under him medical officers (mainly civilian) were recruited. Subsequently when the company found it necessary to maintain a regular body of troops in India they commenced employing Military Surgeons from 1745 onwards. It was not until 1764 that these surgeons were organised into a regular establishment of the company's Armies. Thus the Bengal Medical Service was formed in 1764, the Madras Medical Service in 1767, and the Bombay Medical Service in 1779 for the three Presidency Armies of Bengal, Madras and Bombay. The heads of the Presidency Medical Services were called the Head Surgeons, and they controlled the civil and military needs. In 1825, the post of Inspector General was created in Bombay and Madras. In Bengal a Physician Surgeon was appointed in 1842. In 1857 this post was designated as Director General. The three medical services were in due course combined into one medical service in April 1896 under the Surgeon General to the Government of India. This designation was later changed into Director General, I. M. S.

In 1895, the three Presidency armies were abolished and four Army Commands were created in India and a P. M. O. Surgeon Major General was appointed to each Command. In 1907 when the four Army Commands were abolished and the Army was reorganised into 10 Divisions the P. M. O.'s were granted the rank of Surgeon General. At the same time, the office of P. M. O. to His Majesty's Forces in India came into being. In 1913 the appointment was designated as the Director of Medical Services in India.

Until the First World War, the I. M. S. was predomi-

nantly civilian in character. The number of Indians in the service was very small; but after 1915 their number steadily increased. Until Burma was separated in 1933, the I. M. S. was catering to civil and military needs of Burma also. During this period, the I. M. S. was assisted by the then I. M. D. (Indian Medical Department) and the I. H. C. (Indian Hospital Corps). In 1939 with the outbreak of World War II the idea of reorganising the medical services into a separate Medical Corps exclusively for Defence Services was first conceived and the Indian Army Medical Corps was formed in 1943, and on 14th August 1947, the I. M. S. was finally wound up. Thus, this service lasted for nearly three centuries. Their contribution to the development of medical science in this country has been indeed stupendous, for which we may be proud. This included Curative and Preventive Medicine, Medical Education and Medical Research on an increasing scale, and medical services on the civil side in the Provinces and the centre, as well as for the Armed Forces.

The Indian Army Medical Corps which was created by the amalgamation of the I. M. S., I. M. D. and I. H. C. in 1943 was redesignated "Army Medical Corps" on 26th January 1950. The achievements of the Corps since World War II have been very considerable. In 1949, the post of Director General Armed Forces Medical Services was created as the coordinating head of the Medical Services of the Army, Navy and Air Force. The establishment of the Armed Forces Medical College, where we are assembled this morning, is another great achievement where medical education of the highest standard is being imparted. We must remember, that the quality of medical relief given in any country depends on the quality of medical edu-

cation, so that a medical college occupies a key position in the medical organisation as a whole.

Prior to the introduction of Modern Medicine in India, the Ayurvedic and Unani systems of medicine were taught and practised. This was the case during the Moghul period. During the British regime, the spirit of the Renaissance came to India from Europe and medical research was also taken up, and many important contributions were made by the workers here. I shall refer to one contribution only which will serve as an example of what was done.

We in the Tropics are specially interested in Tropical diseases, the commonest of which is Malaria, which directly or indirectly has been the cause of a large majority of deaths, as well as disability in these regions. This disease was known to the ancients. The cause of Malaria is a parasite, which was discovered by Alphonse Laveran in 1878 and it was Sir Patrick Manson who propounded a theory, that it was conveyed from one human being to another by the mosquito. But the man, who actually proved that mosquitoes were concerned in this transmission was Ronald Ross, who was born in Almora in India in 1857. He was an Officer of the Indian Medical Service, and it was while he was posted at Secunderabad in Hyderabad State, and later in Calcutta that he carried out experiments on mosquitoes and proved that Malaria spread by the bite of anopheline mosquitoes. This was a discovery of vital importance.

For further history of Modern Medicine, I need not detain you much longer. Medicine has made great strides in the 19th century, but the progress in the first half of the 20th century has taken place with a rapidity which was undreamt of before. There is the discovery of X-Ray

and Radium, the conquest of Yellow Fever, the discovery of Vitamins, Insulin, Sulphonamides, Pencillin and other antibiotics. In this battle against suffering and disease, workers in all parts of the world are participating. Medicine in the truest sense of the word is becoming universal, and in this process the World Health Organisation and other International bodies are making a valuable contribution.

In conclusion I may say, that during Renaissance, enormous progress was made. There was rapid evolution of medical thought. The rigid Aristotelian system was replaced by Neo-Platonism. The scholarship advanced quickly, especially in the sphere of observation and experiment. There was a return to the Hippocratic concept of disease. At the same time, as the result of the work of Leonardo, Vesalius, William Harvey, Fallopius and Cesalpino, Anatomy and Physiology advanced as basic sciences. But the most important gift of Renaissance was that of Humanism, consisting in the study of the patient, his behaviour when affected by disease and the investigation of the phenomena of disease by objective methods, a concept interpreted in its most representative form by Paracelsus. This applies to both medicine and surgery. Fracastoro introduced new concepts in the field of epidemic diseases. The establishment of the experimental method by the scientific work of Galileo, the formulation of natural laws when Descartes announced his view that the body is nothing but an automatically operating machine — all these gave a new impulse to the naturalistic concept of the Universe.

Sir M. Foster, F.R.S., Professor or Physiology in the University of Cambridge uttered the following prophetic

words at the close of the 19th century (1900):—

'What we are is in part only of our own making, the greater part of ourselves has come down to us from the past. What we know and what we think is not a new fountain gushing fresh from the barren rock of the unknown at the stroke of the rod of our own intellect, it is a stream which flows by us and through us, fed by far-off rivulets of long ago. As what we think and say today will mingle with and shape the thoughts of men in the years to come, so in the opinions and views which we are proud to hold today, we may, by looking back, trace the influence of the thoughts of those who have gone before. Tracking out how new thoughts are linked, to old ones, seeing how an error cast into the steam of knowledge leaves a streak lasting through many changes of the ways of man, noting the struggles through which a truth, now rising to the surface, now seemingly lost in te depths, eventually swims triumphant on the flood, we may perhaps the better learn to appraise our present knowledge, and the more rightly judge which of the thoughts of today is on the direct line of rogress, carrying the truth of yesterday on to that of tomorrow, and which is a mere fragment of the hour, floating conspicuous on the suface now but destined soon to sink and later to be wholly forgot.'

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XI

CONVOCATION ADDRESS†

I deem it a great honour to have been invited to deliver the convocation address at the College of Physicians and Surgeons of Bombay and I am sincerely grateful for it.

As you know the convocation address originally was to be delivered by His Excellency Shri Girja Shanker Bajpai, the Governor of Bombay, who owing to indisposition was unable to do so. We miss him very much. We feel, however, that his best wishes are with us and we trust that he will be perfectly well very soon.

Many distinguished persons have delivered the convocation addresses here in the past. I am well aware of my own shortcomings. I have been connected with this College for many years in the past and have also the honour of being its Fellow and one of the past Presidents. I regard this invitation as a token of your affection for me for which I offer the President and all of you my sincere thanks. I am delighted to be here with you today and to meet so many of my old friends.

The College of Physicians and Surgeons of Bombay was founded in 1913, with the object of establishing here a recognised body for the encouragement of the study of medicine and surgery in all their branches. The College has a splendid record of good work done in the cause of medical education, both under-graduate and post-graduate,

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† Address delivered at the Convocation of the College of Physicians and Surgeons of Bombay held on 8th January 1954.

Reprinted from *Indian Journal of Medical Sciences*, Vol. 8 No. 5, May 1954.

in this part of India. It has established fine traditions, and I congratulate you for this.

While speaking to you here today the names of many distinguished persons, who were associated with the College in the past, come back to my mind. Time would not permit me to mention them all in detail, but I may refer to one who has guided the destiny of the College in its early years in a most praiseworthy manner. I mean Sir Temulji B. Nariman, who I am sure we all remember with profound respect and affection. He was a great personal friend of mine. He was the doyen of the Indian medical profession and a pioneer in the field of obstetrics. He had a noble personality and in the practice of his profession he observed the highest ethical principles. Sir Temulji's name will always remain a source of inspiration to all of us.

Medicine knows no political or linguistic boundaries. It knows no barriers of distance. All practitioners of medicine belong to one universal brotherhood, whose one aim is to alleviate human suffering and thus promote human happiness. Medicine is becoming more and more international. At the same time on account of rapid communications distance has been annihilated and all countries are becoming more and more conscious of the health conditions in their own land, in comparison with the others. So far as India is concerned, it is painful to note, that the health conditions here are very unsatisfactory. The morbidity and mortality rates in this country are higher than in any Western country. Although much has been done to relieve this distress, much still remains to be done. We are faced here with a multiplicity of preventable diseases which should be prohibited, low standard of nutri-

tion, poor water supplies, bad environmental hygiene, poor communications which hamper our efforts to carry medical relief to remote rural areas in the land, lack of adequate educational facilities, specially in health matters, poverty and many unwholesome social customs. These are some of the factors which we in India have to contend with. The opportunities offered to a medical man to render humane service to our fellowmen in this country are thus really enormous.

After the advent of independence India is the master of its own destiny, and it is up to us to do all we can to set matters right. It is a happy augury of the times that the Government of India and the State Governments are fully aware of their responsibilities in this matter and appreciable progress has been made in this respect during the last few years. As a result of public health measures undertaken, the incidence of malaria, which is India's enemy no. 1, is steadily coming down, as for instance in Bombay and the neighbouring States. Plague also has been completely eradicated in many parts, as for example in Hyderabad.

The Five Year Plan also lays adequate stress on public health and I trust the health conditions in India will steadily improve in the years to come. I can say this with a certain amount of confidence as I have had experience of medical administration in many parts of this country. In carrying out this health programme, many international organisations, such as W.H.O., UNICEF, TCA, etc., are giving our country valuable help, and we are most grateful to them for this.

In providing medical relief on a suitable scale to the people of this country it is necessary to have adequate

trained personnel. Thus the question of medical education is of fundamental importance. In India, there are about 50,000 doctors for a population of 350,000,000, which gives a ratio of about 1 : 7,000. We have about thirty medical colleges. The number of qualified men turned out is approximately 2,000 per year. I may mention, however, that quite a number of new medical colleges have been established in India during the last few years, which is a very hopeful sign. The young men who pass out of these colleges have a wonderful opportunity of serving their fellow country-men. I may also add, that the number of trained nurses and other ancillary personnel is quite inadequate too.

While we do actually feel the need of more doctors, it is necessary that the standard of medical education should be maintained at a high level. In this respect institutions like the College of Physicians and Surgeons of Bombay and the Medical Faculties of Indian Universities have a great responsibility.

We should see that all prospective medical students are thoroughly educated in the Humanities and in Science. Medical education is a lifelong business and it should continue after graduation till the end of one's life.

The character and standard of training imparted depends more on the teacher than on anything else. He influences the minds of the students not only in the classroom but outside also, both by example and by precept. There should be close personal contact between the students and their teachers.

In India the main difficulty at the present time is to get suitable teachers, specially of pre-clinical subjects, namely, physiology, anatomy, etc. We are very short of

them. Special efforts should be made to train suitable young men to take up these subjects. I suppose, one of the reasons for the shortage is that these subjects are not so remunerative as the clinical subjects. Having been a teacher of physiology myself for many years, may I make a special plea on behalf of the teachers of anatomy and physiology, that they should be suitably remunerated so as to attract the best available talent in the country.

Medicine today is no longer merely a matter of prescribing drugs when a person falls ill. The physician has to discharge much wider functions, namely to deal with the social and preventive aspects of disease. Special stress should be laid on social and preventive medicine in the medical curriculum. The health and social welfare of people are closely related with each other. May I make a special plea for the teaching of History of Medicine to medical students. We have no professional chairs of the History of Medicine in any of our medical colleges and universities. This is a serious gap which should be filled as early as possible. To my mind, one important effect of the study of History of Medicine in this country would be that the present controversy between modern medicine and the indigenous systems of medicine, Ayurvedic and Unani, will tend to disappear. Modern medicine has grown out of the ancient systems of medicine, and is the outcome of years of study and progress. The study of medicine with a correct historical background will lead to the unification of medicine in India. Medicine is universal and indivisible. Modern medicine is ever prepared to imbibe all new scientific knowledge, no matter from what source it comes. Likewise medical teachers are united by a common bond and by a humanitarian tradition which

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extends over thousands of years and have a wholesome influence in promoting international goodwill and concord.

The whole essence of teaching is, that the student should learn how to educate himself. He should develop his powers of observation and intellectual curiosity and above all learn the habit of expressing accurately what he has observed.

The teaching in medical colleges should be imparted in an atmosphere of research. The teachers should teach as well as make their own contribution to the advancement of medical science. It is now accepted on all hands that a year's internship at the end of the medical course is essential. This is not a new idea. According to Sir David Campbell, the Emperor Frederick II in 1221 decreed that no one should study medicine, unless 'inter alia' his five years' medical course has been followed by an additional year of practice under the supervision of an older practitioner.

The teaching of medical ethics should form an important part of the medical curriculum. Medicine is not merely a science. It is a wholesome mixture of science and the humanities and for that reason it stands on a higher pedestal than pure science itself. For a doctor not to show human kindliness and sympathy to his patients is as much a crime against science as against humanity.

You may pardon me for making a special reference to medical education. The subject of medical education is very close to my heart as I have devoted a large part of my career to the service of the Grant Medical College at Bombay. We, who are interested in medical education should profit by our own experience and should give of

our best to the younger generation. It should be our aim that our young friends who are now entering the medical colleges have even better education than we had in our days.

While talking on medical education, may I also invite your attention to pharmaceutical education which also needs to be properly regulated in this country. I have just come from Madras after attending the Annual Pharmaceutical Conference there. The President of that Conference, Mr. P. M. Nabar, truly remarked, that doctors and pharmacists are like two wheels of a chariot. In order that the chariot may move properly it is necessary that the two wheels should move in close harmony and co-operation with each other. Both the pharmacists and the doctors are inspired by the same ideals and have the same objects in view, namely, relief of human suffering. I am glad that this harmony exists in India but there is need for them to get closer together.

Today we are living in a scientific age. Owing to the invention of atomic weapons of warfare sometimes some people cast grave doubts on the usefulness of science. But this is not true of medicine. According to Bertrand Russell, Science as a dominant factor in determining the beliefs of educated men has existed for about 300 years. Scientific medicine had at first to combat superstitions similar to those that inspired belief in witchcraft. It is only from the time of Lister and Pasteur, that medicine can be said to have become scientific. The diminutiion of human suffering owing to the advance of medicine is beyond all calculation. By the growth of medicine, science has alread conferred an immense boon on mankind. And here there is no question whatever of using

medicine for any other purpose than for the welfare of the human race.

May I address a few words directly to the young men who have just received their diplomas: I offer you my sincere congratulations on having successfully worked and received your diplomas. You are now entering the medical profession which is rightly described as the noblest profession of all. I welcome you all most cordially, and wish you a most successful career. You will have wonderful opportunities of doing good to your fellow countrymen. Be loyal to your *alma mater* where you have received your training, and to your colleagues in the medical profession whom you should always regard with due courtesy and consideration. We are all like true brothers in the medical profession. Practise medicine with a real spirit of service. Be charitable and kind to all who come in contact with you. Be sympathetic to your patients. Face all difficulties with calmness and courage. Acquire the habit of punctuality and thoroughness in your work. Observe the highest ethical principles in the practice of your profession. Remember that your country needs you most urgently, and that the need is greater in the rural areas than in the urban. Therefore, go to the remote parts of the country where medical relief is scanty. All State Governments today are paying special attention to the extension of medical relief in the rural areas, and you will have wonderful opportunities there to do good to your people. Remember also that India has made great contributions to the science of medicine in the past, perhaps more than any other nation. We are justly proud of it. It is in the glorious remembrance of the past that nations as well as individuals find their noblest inspiration. Let

India's glorious past be a source of inspiration to you and you too in your turn should try to make your contributions to medical science. Your greatest reward will be your own satisfaction of noble work well done. Once again, my young friends, I wish you all well and I pray that God may bless you and grant you every happiness, prosperity and success in your task which lies ahead.


St. John's Medical
LIBRA

XII

OUR MEDICAL HERITAGE*

I consider it a great honour and privilege to have been invited to deliver this lecture on "Our Medical Heritage" in Armed Forces Medical College, Poona. I am delighted to be in your midst. I am sincerely grateful for this to Air Vice-Marshall M. M. Shrinagesh, the Commandant of this College. This will be my second lecture at this College. The first lecture was delivered by me here on 28th July 1964 on *"The Renaissance and the Evolution of Medicine."* I am very happy that in this great teaching institution a good deal of interest is being taken in the study of History of Medicine, a subject which, to my mind, is of very great importance.

As we look back and make a careful study of the past cultural achievements of our country, we realise how fortunate we are in having such a splendid heritage, a heritage, which is so broad-based, that it covers a vast field of human thought and speculation, including religion, philosophy, literature, Science and Medicine. The study of Indian history and culture is of great importance. It should be a part of the equipment of all our educated alumni. We should be aware of our cultural heritage. Today, we shall confine ourselves to the consideration of our Medical heritage.

The Science of Medicine, like other Sciences, was carried to a very high degree of perfection by the ancient Hindus.

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* Address delivered at the Armed Forces Medical College, Poona, on 9th December 1969.

Reprinted from *Armed Forces Medical Journal*, India, Vol. XXVI No. 3, July 1970.

Their great powers of observation, generalisation and analysis combined with patient labour in a country of boundless resources, whose fertility for herbs and plants is remarkable, placed them in an exceptionally favourable position to prosecute their studies of Medicine.

The Ayurveda, or the Science of Life, is the oldest system of Medicine in the world. The study of its history is rather difficult, as there is lack of information regarding dates, places and authorship etc. India, unlike China, enjoys a unique position in that India instead of being isolated culturally and scientifically, as was the case with China, has been freely exchanging its knowledge for centuries with other countries. According to Professor Wilson, "In ancient India, the Hindus kept pace with the most enlightened nations of the world, attaining as thorough a proficiency in Medicine and Surgery as any people whose achievements are recorded. There is evidence that it was common practice amongst the ancient Aryans to migrate to different lands, such as Persia, Arabia, Egypt, Babylonia, Greece and even Scandinavia, carrying with them their vast knowledge and experience." In those days, the practice of Medicine was a prerogative of the priestly class, but they displayed a high standard of surgical and therapeutic skill.

Ayurvedic Medicine goes back to the days, when the Aryans came to India from Central Asia about 2000 to 3000 years B.C. Even in the Prevedic period as indicated by the excavations at Mohenjodaro and Harappa, hygiene and sanitation had reached a high level of development, for one finds the existence there of open streets, drains, baths and wells in the inhabited areas. The early history of Medicine here as elsewhere is shrouded in mystery. It

is interesting to note that the ancient compilers of Medicine in India have described Medicine as a gift of God. Ayurveda or the Science of Life is said to be bestowed by Indra on Bharadwaja, who was deputed to go to him by the assembly of sages, who met in the Himalayas. Atreya, the great sage, probably a pupil of Bharadwaja, was a great teacher of Medicine. Agnivesa, the distinguished pupil of Atreya, undertook the herculean task of codifying the knowledge imparted by Atreya and to arrange it in the form of a treatise, which formed the basis of *Charak Samhita*, the immortal Medical Classic written by Charak, one of the greatest physicians of ancient times. The other great Indian Medical Classic is *Sushruta Samhita*, which contains a great deal of Surgery, in which the ancient Indians specially excelled. They set fractures, performed amputations, excised tumours, repaired hernias, and did couching for cataract. They were pioneers in doing plastic surgery and did Rhinoplasty. Hygiene played a great part in Indian Medicine. The Laws of Manu are important from the Medical point of view, as they enjoin strict personal hygiene and frequent ablutions as the basis of religious worship.

Atreya was the first systematic teacher of Medicine. There is evidence to suggest that he taught Medicine in the 8th century B.C. before the time of Buddha and prior to the establishment of the University of Taxila. Atreya stands first amongst the teachers of Ayurveda and is often referred to as the *"Father of Indian Medicine."* According to him "All suffering, whether of the body or of the mind has for its basis ignorance; all happiness has its foundation in pure scientific knowledge."

In Surgery, Sushruta is rightly regarded as the *"Father of Indian Surgery."* He obtained his knowledge from Dhan-

vantari, the patron saint of Surgery. Sushruta became the head of the departments of Medicine and Surgery at the great University of Varanasi, but he assigned a somewhat higher place to Surgery, regarding it as the first and highest division of the healing art. He, however, says that "both Medicine and Surgery must go hand in hand, for he who only knows one branch of the art of healing is like a bird with one wing."

Ayurvedic Medicine is based on the humoural theory of Vaata, Pittha and Kapha. Vaata, Pittah and Kapha are the supporters of the human body. They together contribute all the nutritive fluids derived from solid, liquid and gaseous food materials ingested by the human organism. They are, therefore, called the Supporting Dhaatus (Poshaka Dhaatus).

Vaata, Pittha and Kapha are considered the most essential factors in the constitution of the human body. When they are in equilibrium, the body is healthy. But any variation in them or vitiation of any one of them causes ill-health or disease.

Influence of Buddhism

Ayurvedic Medicine had reached a high level of development in the old days and Buddhism provided an added stimulus to its advancement, especially, in the establishment of hospitals. The Buddhistic period represents the era of rational or scientific Indian Medicine. It began with Gautam Buddha about 600 years B.C. By denouncing various sacrificial rites and the system of caste and by extolling the qualities of mercy, love, kindness and goodness as stepping stones to peace—Nirvana, Gautam Buddha was able to change the entire face of the Art of

Healing. Although magic spells and miraculous cures were practised at the time, the individual efforts of great teachers of Medicine and Surgery, were successful in uplifting the ancient Medical Science of India to a high level of proficiency. The ancient Universities of Taxila and Nalanda became famous for their teaching of Medicine, Surgery, Philosophy, Mathematics, religion and other Arts and Sciences under the guidance of eminent teachers.

Establishment of Hospitals:—During the reign of Chandragupta (324–300 B.C.) special attention was paid to the establishment of hospitals and dispensaries and for enforcing rules of sanitation. Asoka (272–232 B.C.) who was a sincere follower of Buddha took active part in this campaign. In Asoka's rock edict No. II, it is inscribed as follows:

"Everywhere in the dominions of King Priyadarsi, Beloved of the Gods, and likewise in the bordering territories such as those of the Chodas and Pandyas as well as of the Satiyaputra and the Keralaputra as far south as Tamraparni, and in the territories of the Yavana King Antiyoka—everywhere King Priyadarsi, Beloved of the Gods, has arranged for two kinds of medical treatment, viz., medical treatment for men and medical treatment for animals. And wherever there were no medicinal herbs beneficial to men and animals, everywhere they have been caused to be imported and planted. Wherever there were no roots and fruits, everywhere they have been caused to be dug and trees have been caused to be dug and trees have been caused to be planted for the enjoyment of animals and men."

Jeevaka was the most famous physician in Buddha's time in the 8th century B.C.

Ancient Indian Hospitals

The Chinese Pilgrim Fa-Hien, who visited India in the time of Emperor Chandragupta states:—

"The elders and gentry of these countries have instituted in their capitals free hospitals, and hither come all poor or helpless patients, orphans, widows and cripples. They are well taken care of, a doctor attends them, food and medicine being supplied according to their needs. They are all made quite comfortable and when they are cured they go away." Fa-Hien also mentions "Houses of charity on the roadside where rooms, couches, beds, food and drink are supplied to travellers, while the rich and prosperous inhabitants, cying with one another in the practice of benevolence and righteousness establish in the cities houses for dispensing charity and medicines."

It is interesting to note that some of the religious and charitable endowments of Southern India were made for the establishment of Schools, which were equipped with a hostel for the residence of students ,and also a hospital. Inscription No. 182 states how by the royal grant of Veera Rajendra Deva (A.D. 1062), there was established such an institution. The hospital attached to the schools was known as Veera-Solan and was provided with 15 beds. The staff and establishment for the school-hostel and hospital comprised one physician, in whose family, the privilege of administering medicines was heredity, one surgeon and two servants, who fetched drugs, supplied fuel, and did other services for the hostel and the hospital.

The private charities of the day were also supplied for the establishment of maternity homes. This is mentioned

in the Madras Epigraphic Report for 1917 p. 122, recording a pillar-inscription in a Taluk of Guntur District, of the time of Kakateeya Kings.

Spread of Hindu Medicine in Foreign Countries

Tradition says that many illustrious men from Greece and other foreign countries visited India and took back with them the Hindu Sciences and introduced them in their schools. Alexander the Great is said to have taken with him some Indian Physicians after his Indian campaign, being attracted by their successful cures of snake bites. The Buddhist monks, who were sent out to foreign countries by Asoka, preaching Buddhism, practised Medicine as part of their humanitarian task. They studied medicine along with philosophy and fortified their spiritual ministry by relieving the sufferings of people.

It is interesting to see how Buddhism spread to China, and Ayurvedic Medicine went there along with it.

Buddhism was transplanted from India into China about 67 A.D. Emperor Ming Ti (58–76 A.D.) of the Eastern Han sent an Embassy of eighteen men to India to ask for Buddhist books and teachers. This action was the outcome of a dream which the Emperor had in which he saw a good image of Buddha, who demanded to be worshipped in China. The messengers left the capital (Lon-Yang, now known as Honan-fu) in 63 A.D. They travelled across central Asia, until they reached Khotan. The embassy brought back with it the images of Buddha, Buddhist scriptures and two Buddhist monks, Kasyapa Matanga and Gobarana from India. Gradually Buddhism gained a strong hold until the Tang Dynasty, when it enjoyed the greatest prosperity. As the result of the frequent pilgrimages

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made by enthusiastic Chinese Buddhists to India, and the arrival of many Indian monks in China, the Art, Science and other phases of Indian Culture, including Medicine exerted a profound influence on the life and thoughts of the Chinese people. The views about the etiology and pathology of diseases were affected by Buddhistic ideas. "Humanity suffers from two kinds of afflictions, physical and mental. For physical ailments, the drugs of Pien Ch'iao will be effective, but for mental afflictions nothing but Buddhist medicine is required" (Wong and Wu). Buddha is said to have told Chi Po: "You go and heal his body first, I will come later to treat his mental suffering." It seems, that faith-healing, hypnotism, autosuggestion and other psychotherapeutic measures mostly originated from Buddhism. Out of this arose the art of meditation, a system of mental exercise, which aims at developing the mind to a state of mental repose or relaxation.

Let us briefly consider the Ethical principles laid down in Ayurveda.

Ethical Principles

To begin with, in admitting students to the study of Medicine, as much importance was attached to the moral fitness as to the intellectual and physical fitness of the pupils, for it was considered axiomatic in those days, that moral excellence was the basis of all true education, including medical education. The object of education was not merely to prepare the student to earn a livelihood, but also to infuse into him a strong desire to lead a good and virtuous life. Further, there was very intimate contact between the teacher and the student, so much so, that during the period of education the teacher was ac-

my behest or otherwise, thou shall conduct thyself for achievement of thy teacher's purpose alone to the best of thy abilities.

"If thou desirest success, wealth and fame as a physician and heaven after death, thou shalt pray for the welfare of all creatures.

"No offering of gifts by a woman without the behest of her husband or guardian shall be accepted by thee. While entering the patient's house thou shalt be accompanied by a man, who is known to the patient, and who has his permission to enter and thou shalt be well clad and bent of head, self-possessed and conduct thyself after repeated consideration. Thou shalt thus properly make thy entry. Having entered, thy speech, mind, intellect and senses shall be entirely devoted to no other thought than that of being helpful to the patient and of things concerning him only.

"The peculiar customs of the patient's household shall not be made public. Even knowing that the patient's span of life his come to its close, it shall not be mentioned by thee there, where if done so, it would cause shock to the patient or to others.

"Though possessed of knowledge, one should not boast very much of one's knowledge. Most people are offended by the boastfulness of even those, who are otherwise good and authoritative."

On the completion of the initiation ceremony, the student was designated as a Bramhachari and he retained this title till the end of his student life. During his student life, he was specially instructed to observe celebacy, not to carry weapons, not to indulge in rebellious or immoral acts. According to Kasyapa, he was advised as a Brahma-

chari to keep a liberal and receptive mind and make his contributions to the growth of knowledge and progress generally.

The Convocation or Samavartana Ceremony:

After the conclusion of studies, the young physician was advised according to *Charak Samhita* as follows:—

"Having finished his studies and permitted to leave the school, he should go about wearing white garments with clipped hair, with undeluded mind and with his eyes looking straight before him. He must never resort to the patient's house uninvited. Having entered, he must scrutinise the prognostic omens. He should not turn his gaze on anything else in the house but the patient. He should not make his entry into a house without announcing himself. He should not broadcast the secrets or the shortcomings of the patient's household. He should withhold from the patient the untoward prognostic signs, that he may perceive. He should continually offer consolation to the patient. He should not administer the medicine in the wrong order, nor should he delegate the responsibilities to another. He should make an altogether novel combination and administer it. He must be versed in the knowledge of characteristics of constitutions, drugs, disease and age. He should always be equipped with the store of fumigating drugs eyesalves and other medicine. He should not incur the hostility of other members of his profession. In co-operation with them, he should prepare the medications. He should be given to speech that is bold, unambiguous, prompt, vivid, charming, gentle, persuasive, comprehensive, non-contradictory and righteous. For indeed, the physician who desires the well-being of people enjoys happiness in this world as well as in the other."

These oaths formed the basis of Ethics of the Physician.

Registration:

After finishing one's medical education, one had to obtain the permission of the King to start one's professional career. This was the practice in ancient India. This is what Sushruta says:—

"Having studied the Science, having fully grasped the meaning, having acquired practical skill and having performed operations on dummies, with ability to teach the science, and with the King's permission, a Physician should enter into his profession."

—*Sushruta Samhita*

This was done to protect the people from quacks and Charlatans.

Sukracharya also states positively that without the permission of the King, no physician should be allowed to treat.

Ayurveda is deeply rooted in the soil of India and a large majority of the people still seek comfort from it. It has largely contributed to our cultural heritage.

War and Medicine:

To this audience in the Armed Forces Medical College, it would not be out of place if I briefly refer to the effects of Warfare on the progress of Medicine. This is also important so far as our medical heritage is concerned.

War is always a challenge to the Science of Medicine. During the War the Nation's Medical resources are brought severely to test. But it also provides opportunities for experimentation, which result in new concepts and discoveries.

Of all branches of medicine, surgery is the one which has responded most to the war challenge. Since ancient times, army surgeons have accompanied the armies. This was the case in ancient India. This also happened in ancient Greece, when Grek Surgeons travelled with the armies of Alexander the Great. They came to India in this way and met the physicians in our own land from whom they learnt a great deal. Some Ayurvedic Physicians were taken by Alexander with him back to Greece.

It should be borne in mind that medical and surgical knowledge is transmitted not merely by means of books but largely in a practical way, when knowledge and experience are transmitted by personal contact between colleagues. In this process, wars have played an important part. To any army surgeon, the management of injuries received in the fighting on the battlefield is a matter of vital importance. In carrying out this humanitarian task since ancient times, he has made great contributions to the advancement of surgery. In the Indian literature of the Vedic period we find very accurate descriptions of the effects of haemorrhage and treatment of injuries. In *Atharvanaveda* certain disciplines are laid down for the training of the army surgeon before engagement in battle.

Unani System of Medicine:

Apart from the Ayurvedic, the other old system of medicine in vogue in the country is the *Unani*. The word Unani means Greek. This is the old Greek Medicine, which had reached a very high stage of development. The rational attitude towards life, which the Greeks acquired also influenced their attitude towards disease and death. The greatest of the Greek Physicians was Hippocrates, who is known as the Father of Medicine. He was a con-

temporary or Plato, and lived from 460 B.C. to 357 B.C. His teachings are contained in the *Corpus Hippocraticum*. His great achievement consisted in having disassociated Medicine from Theology and Magic. He laid stress on the clinical examination of the patient more than anything else. He introduced ethical principles in the practice of Medicine. The Hippocratic Oath, which is well-known all over the World is as follows:—

The Hippocratic Oath:

"I swear by Apollo the physician and Æsculapius and Health and All-Heal, all the gods and goddesses, that, according to my ability and judgment I will keep this Oath and this stipulation — to reckon him who taught me this Art equally dear to me as my parents, to share my substance with him and relieve his necessities if required; to look upon his offspring as equal to my own brothers, and to teach them this Art if they shall wish to learn it, without fee or stipulation; and that by prefect, lecture, and every mode of instruction I will impart a knowledge of the Art to my own sons and those of my teachers, and to disciples bound by a stipulation and an oath of obedience to the law of medicine, but to none other. I will follow that system of regimen, which according to my ability and judgment, I consider to be for the benefit of my patients, and abstain from whatever is deleterious and mischievous. I will give no poison to anyone even if asked, nor suggest any such counsel; and in like manner I will not give a woman a pessary to produce abortion. With purity and with holiness I will pass my life and practise my Art. I will not cut persons suffering from stone, but will leave that to be done by men who are practitioners of this work. Into whatever houses I enter

I will go into them for the benefit of the sick, and will abstain from all intentional mischief and harm, especially from the seduction of females or males, freemen or slaves. Whatever, in connection with my professional practice, or even outside it, I see or hear in the life of men, which ought not to be spoken of abroad, I will not divulge, reckoning that all such things should be kept secret. While I continue to keep this Oath unviolated may it be granted to me to enjoy life and the practice of the Art among men for all time! But should I trespass and violate this Oath may the reverse be my lot!"

.....

Hippocrates raised medicine to the status of Science and placed it on a high pedestal by combining with Humanities.

By the first century of the Christian Era, the centre of civilization had shifted from Greece to Alexandria and then from there to Rome. But medicine in Rome was Greek Medicine and all the great physicians in Rome were Greeks T.he greatest name in Graeco-Roman Medicine after Hippocrates was Cladius Galen (131 A.D. to 200 A.D.) whose influence remained dominant in Europe for 1200 years. He codified all medicine of the time and made many contributions of his own. When Roman Empire broke up, its culture disappeared from Europe for a thousand years. But many of the medical works of Hippocrates, Galen and other Greek physicians had been safely evacuated to Constantinople. From there, the knowledge spread to Arabia, Mesopotamia and Persia.

Medicine in Persia and Arabia was partly Greek and partly Indian. According to Professor Browne, "Arabian Medicine is that body of scientific or medical doctrine, which is written in Arabic language, but which is for the

most part Greek in its origin, though with Indian, Persian and Syrian accretions, and only in a very small degree the product of the Arabian mind." Its importance lies not in its originality but in the fact that in the long interval which separated the decay of the Greek learning from the Renaissance it represented the most faithful tradition of ancient wisdom and was during the Dark Ages the principal source from which Europe derived such philosophical and scientific ideas as she possessed. This medicine developed in Persia and Arabia, particularly under the enlightened patronage of the Abbasid Khalifas of Baghdad in the 8th and 9th centuries A.D. There are two great names of eminent physicians of this period, namely, Rhazes and Avicenna, who played an important part not only in introducing Greek medicine in Arabia, but also in the revival of learning in Europe. The principal service of Islam to Medicine was the preservation of the Greek culture.

It was this system which came to India with the advent of Mohammadans. During the reign of the Moghul Emperors it reached the height of its glory. There were many distinguished Hakims who taught and practised it in many parts of the country, namely, Lahore, Delhi, Agra, Lucknow, Calcutta, Hyderabad and other places.

Emperor Akbar collected at his Court many distinguished Hakims (Physicians) such as Hakim Abul Fatech Gilani, Hakim Rutfullah Gilani and Hakim Ainul-Mul Siraji. According to the advice of Hakim Abdul Fateh Gilani, many hospitals were established in the kingdom. An account of these is given in *Akbar Nama* (Vol. 3, p. 3). Munshi Lalchand has referred to these hospitals in his history of Agra.

After Akbar, when Emperor Jehangir ascended the throne, he issued the following proclamation at the time of his coronation in 1041 H.E.:—

"In all big cities, hospitals should be established for the treatment of the sick and the expenses for running these hospitals will be paid by the Government."

Emperor Shah Jehan followed the example set by his predecessors and made special efforts to establish hospitals. He established one hospital behind the Jammai Masjid at Delhi in 1060 H.E., to which he appointed some well-known Hakims.

Emperor Aurangzeb also established several hospitals in his kingdom.

Among the very able Unani Physicians during the Moghul period, Hakim Ali Gilani occupies a high rank. He wrote a very fine commentary on Avicenna's Canon of Medicine. Among others, I may mention the names of Hakim Hasan Gilani, Hakim Sanaulah Khan of Farrukhabad and Hakim Mohammad Akbar Arzani who wrote an important book on Medicine.

During the Moghul period many books were written on Unani Medicine. The well-known book *Madanushifa Sikarshahi* contains commentaries of Unani Medicine and incorporates many useful thigs from Ayurvedic Medicine. Special attention was paid to the medicinal herbs in India and books written on them. Medical Schools for giving instruction in Unani Medicine were established at Lahore, Delhi, Agra, Lucknow and Hyderabad (Deccan).

At Lucknow Mirza Ali Khan Sahib ranked high. He was the physician of King Shah Gaziuddin-Hyder of Oudh. It is recorded that he was known by the title

"Hakim-ul-mulk." Hakim Abdul Azis established in Lucknow the well-known institution known as Tak-mil-u-Tibb.

There were some well-known Hakims in Lahore, Bhopal and Rampur. In Delhi, the name of Hakim Ajmal Khan is well known and in Hyderabad (Deccan) Mir Fazal Ali Khan. There were also Hakim Ahmed Syed Amrobi, who was the Director of Medical Services in the Deccan and Hakim Mohammad Abdal Aziz Khan Sahib, who was physician to H. H. Mir Mahboob Ali Khan Asafjah and Hakim Syed Altaf Hussain Sahib, who was also appointed as the Director of Medical Services.

It is to be observed that as the Mohammedans in Baghdad had absorbed Greek as well as Ayurvedic medicine, in India too, they adopted Hindu Sciences and Art including Hindu medicine to a great extent. They translated many Sanskrit and Hindi books into Persian. They paid the same attention to Ayurvedic medicine as they did to Greek medicine at an earlier period. So the Unani Medicine which is practised today is a blend of both Graeco-Arabian and Ayurvedic Medicine.

Unani Medicine, like Ayurveda, is also based on the humoural theory. According to it, the world consists of two types of matter, gross and subtle. The gross matter comprises Earth, Water and Air, while the subtle matter consists of Energy and Soul. For the medical men energy is of importance and it is symbolized by fire. All the elements interact with each other. In the human body four humours are produced, namely, Khoon, Sajra, Souda and Balgham. These are responsible for the replacement of tissues wear and tear and for supplying energy to the body. When humours become abnormal, they cause ill-

health. There is a view that under certain circumstances *ufoonath* may be caused due to these humours, which may result in diseased conditions. *Ufoonat* means the occurrence of changes leading to lowered resistance.

There were schools of Unani at Lahore, Delhi, Agra, Lucknow, Hyderabad (Deccan) and other places. It came in contact with Ayurvedic Medicine, from which it imbibed many important ideas about diagnosis and treatment.

Modern Medicine:

The modern system of Medicine which developed during the Renaissance in Europe was introduced into India as a result of our contact with the Western Nations, especially, the British. During this period medical services were established for the Armed Forces as well as for the civil population. Medical Colleges and Medical Research Institutes were started and measures introduced for the prevention of infectious diseases, and the promotion of public health and Hygiene.

Concluding Remarks:

This is the story of our Medical heritage, which is of a diverse nature. We are a Nation possessing a culture which is composite in nature, and history teaches us that we have a special genius for bringing about integration and synthesis of different ideologies. We should try to synthesize all that is best in our ancient medical heritage and modern medical science.

For the knowledge and appreciation of our medical heritage, the study of the history of Medicine is vitally important. It is specially helpful at the present day. This study helps us to absorb the high standard of ethics laid down in the past, to respect the antiquity of the art of

healing, to inspire us with a love of our profession and to appreciate and admire our past traditions. All this will be a source of inspiration to us in carrying out our daily task. It will help us to imbibe the essential quality of humility and moderation, while considering the advancement in medicine, which is taking place in our times. And what is most vital, it will stimulate our general culture by reviving a closer relationship with history, literature, art and general science. As Pusey (1928) says: "In the first flush of opulence and success there is no state of mind so difficult to maintain, or so necessary for future services as humulity." This position will be rectified by the study of history, and by the appreciation of our splendid medical heritage.

Further, it will also help us to realise that Medicine, like any other Science such as Physics, or Chemistry, is one and indivisible. It does not admit of any division into so called "Systems." This Science is universal in its scope and outlook and many countries both in the East and the West have made and are making contributions to it. It is also vitally important that we should realise that Medical Science has made great strides during the last 300 years and some of the advances have been of a revolutionary character, so that our efforts in the sphere of curative and preventive medicine are more effective now than ever before. This is due to the fact that all problems are considered in an objective manner and our approach to them is through observation and experimental methods, which have indeed furnished us with a rich harvest of useful knowledge, and we should pursue them with all the zeal and resources at our command.

This is just a brief account of our past medical heri-

tage. It is primarily based on the ancient Hindu medicine which had advanced a great deal in the past. Subsequently to it were added Unani Medicine and the Modern Medicine. If Charak and Sushruta, Hippocrates and Galen, Rhazes and Avicenna, Pasteur and Lister were alive today, they would have advised us to continue the task which they had commenced and make further contributions to the Art of Healing. They would also impress upon us the necessity of dedicating ourselves to this Science with a spirit of service. In this context, I earnestly wish you, my young friends in this College, the best of luck and success in the task that lies ahead.

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